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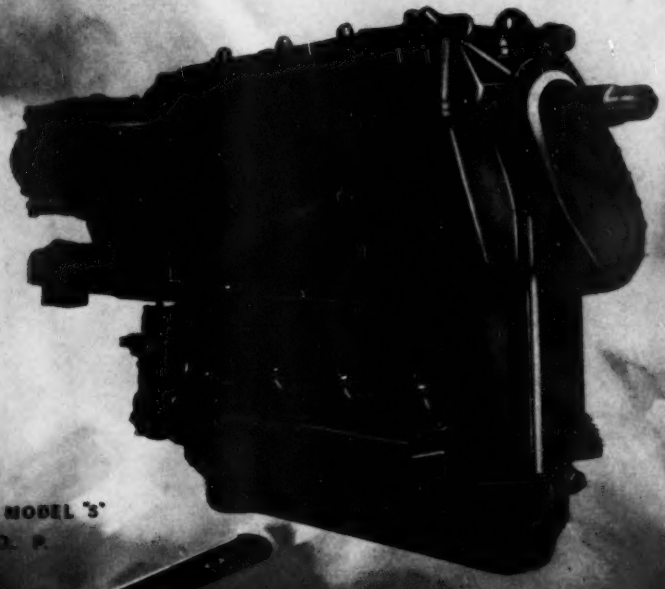

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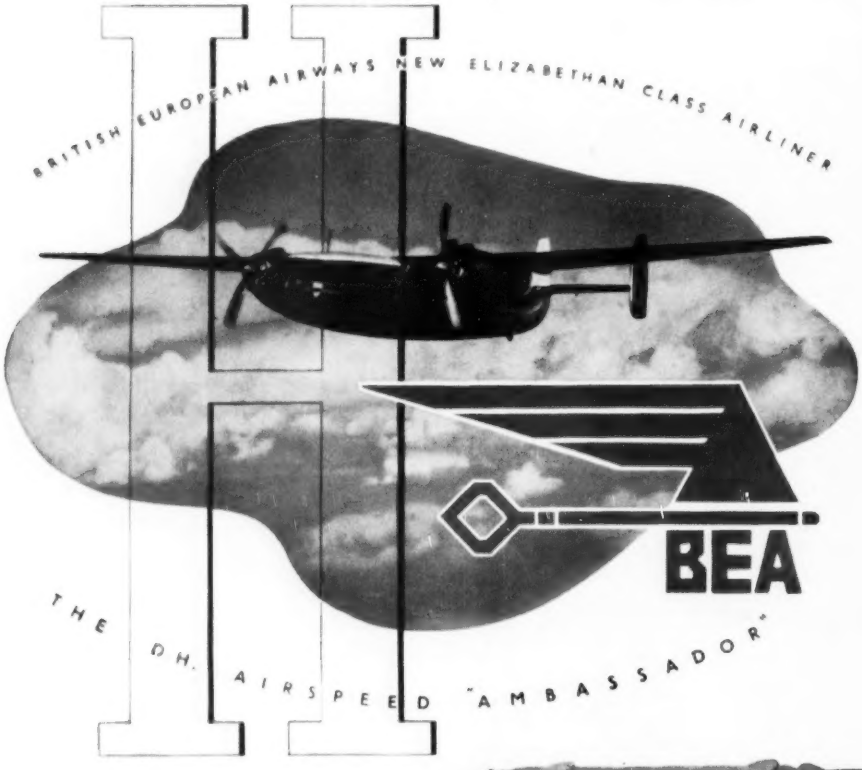

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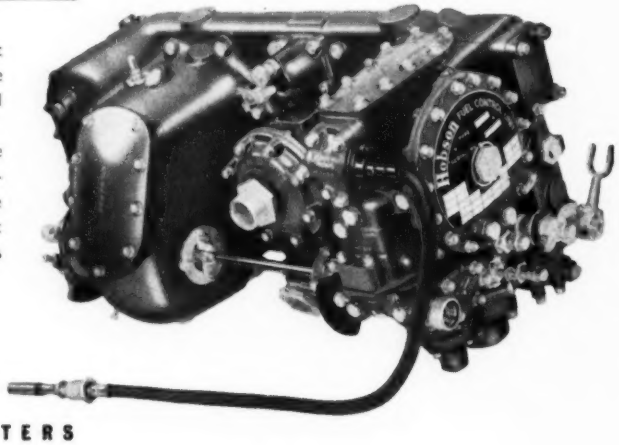

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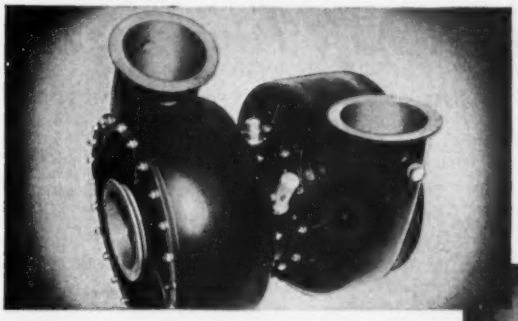

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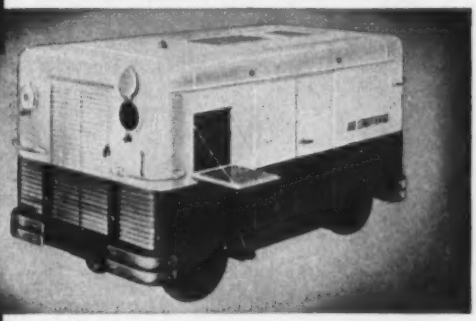

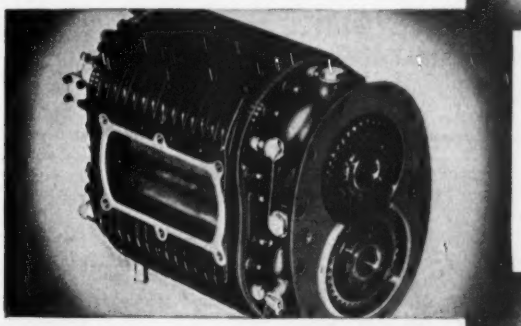

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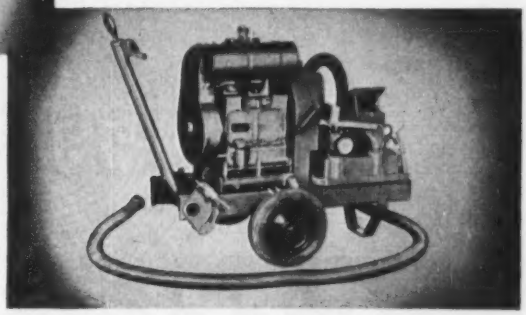

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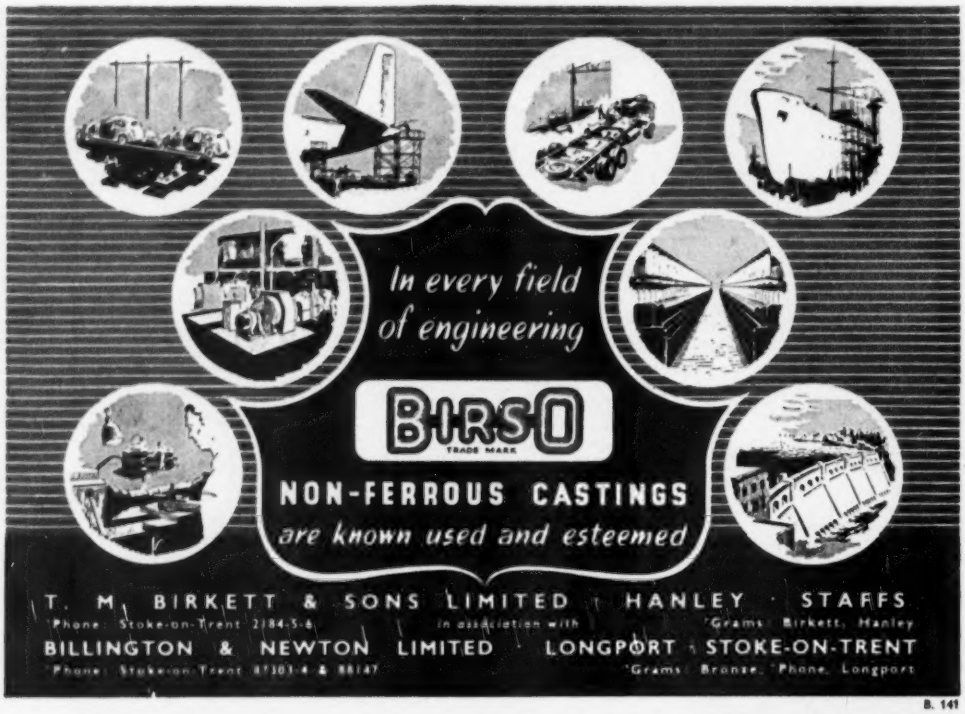
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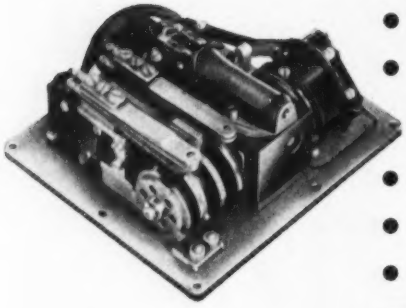

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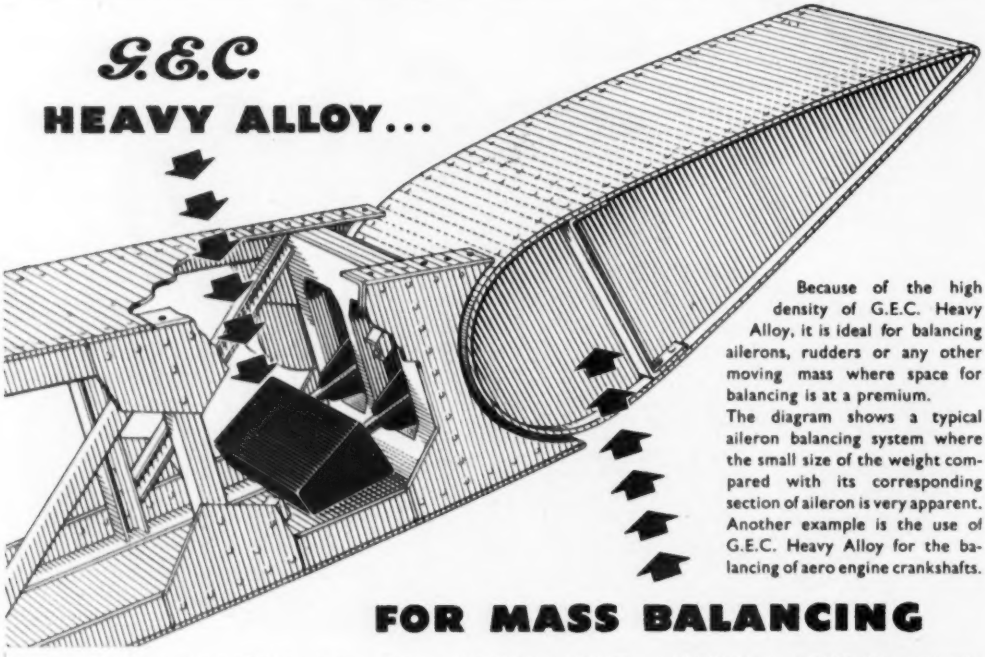

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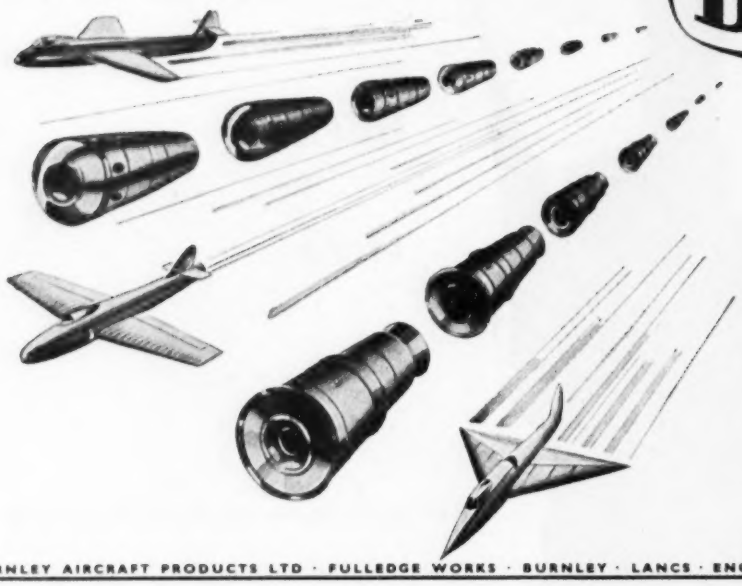

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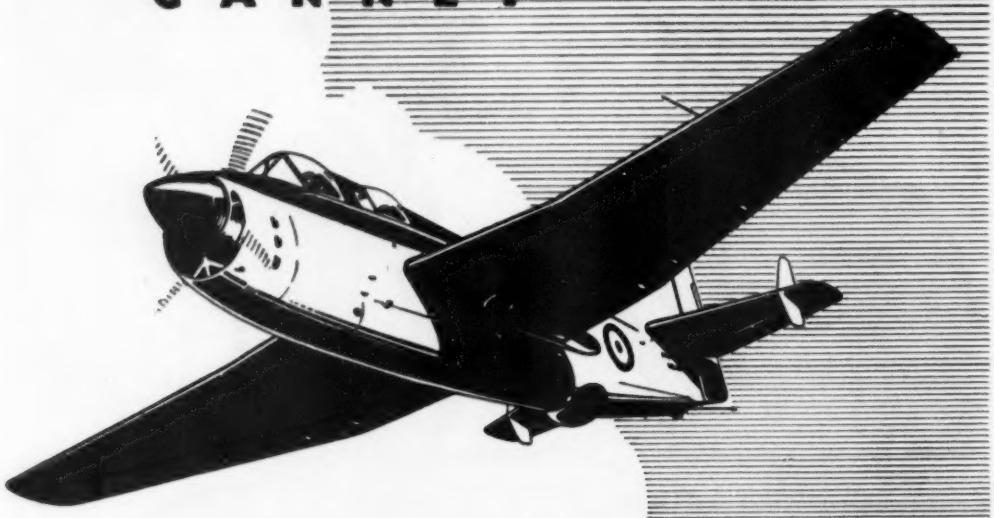

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IN THIS ISSUE:

Training Naval Air Observers - - - - - 550
Britain's Atomic Weapon - - - - - 551
The Viking in Operation 556
Over the Top - - - - 561
Conversion to Rotating Wings - - - - - - 562
Probing and Drogueing 567
Supersonic Bangs - - - 569

Air Defence: The Intractable Problem

BEFORE taking over the most responsible and strenuous duties of Chief of the Air Staff, Air Chief Marshal Sir William Dickson is now making a personal examination of Air Force and other establishments round the world. Recently he has been in Australia, where he has been subjected to some searching questioning. Sir William is a man who gives straight answers, and it is the more direct questions regarding home defence, guided missiles and atomic developments which interest us particularly. He talked of these three matters, all of which are inter-related and of special concern to both Australia and Britain. Australia is not only concerned because of the Woomera rocket range—"a great national asset"—and the Monte Bello atomic test, but because the people of the Commonwealth have always shown a quite remarkable and heart-warming solicitude for the safety and well-being of Great Britain.

The C.A.S. designate was asked about progress with home defence, and was able to give encouraging information about the "vastly superior" early-warning radar, undoubtedly a cornerstone of our fortifications. He was "confident that any aggressor would meet formidable opposition, which was continually being improved," and he said that new secret weapons being tested at Woomera could be a first-line defence in air attack, as well as being weapons of attack. He was much impressed by the equipment and scope of the Woomera range, but voiced the opinion that at least ten years will elapse before piloted intercepters are replaced by guided missiles.

While the Air Chief Marshal talked of these matters in Australia, "Ardent," the largest defence exercise to be conducted in this country, was (and is still) being assessed at home, with the aid of thousands of combat reports and films. Most daily press stories of the exercise painted, we feel, a rather over-optimistic picture; and they were followed by the first official appraisals by senior officers, which to some people carried a suggestion of complacency. This was no doubt because results had in fact been much better than on previous occasions, and a very great number of interceptions had been recorded both by night and by day.

That bombers of the B-29 and B-50 types proved to be easy to find and intercept by all types of jet fighter is good news in one sense, but until shells are fired in anger the ability of bomber formations to defend themselves against modern fighters must remain largely conjectural. On the other hand, unarmed Canberras of the attacking force were quite another matter, and their success in penetrating the defences at high altitudes is again in one sense, good news. The latest jet fighters to be delivered, of which a handful were operating, together with some Canadian and American Sabre squadrons, fortunately showed a marked superiority over earlier types in dealing with Canberras and fighters simulating jet-bomber raids.

If atom bombs are to be used in any future war, then the aim of the defences must be 100 per cent interception and destruction; this, unfortunately, is a target virtually impossible to achieve. On the other hand, if raids are made expensive enough, they cannot be often repeated. Even when ground-to-air missiles become available in large numbers, and 100 per cent interception is at least theoretically possible, there will no doubt be counter missiles, guidance-jamming and deflecting fields around aircraft. If those machines which carried atomic weapons could be detected among the others which did not, the defences would know upon which single aircraft or group of aircraft to concentrate.

While strong defences must be preserved, the ability to hit back harder and more quickly may prove to be an even greater deterrent, and there are indications that this sort of thinking and planning is on the increase at top levels. Sir William Dickson stressed in Australia that all jet bombers in the Royal Air Force will be able to carry the atom bomb.

It is a good sign, we believe, that the C.A.S. designate is not only interested in the domestic affairs of the R.A.F. and in the purely technical subjects, but clearly has his eye on those broader matters of defence about which the British peoples are most concerned.

Dummy run: Training in anti-submarine warfare is one of the major aspects of the Observer School course. In this striking picture a Barracuda from St. Merryn is exercising with a submarine.

TRAINING NAVAL AIR OBSERVERS

Success of a New Intensive System at R.N. Air Station St. Merryn

TO speed the output of its air observers, and to improve their training, the Royal Navy has recently reorganized the system. The training process is now concentrated at one establishment, and the overall time required to turn out the finished product has been shortened.

The change is timely, for the integrity of our sea communications is the Navy's first charge. The advent of the Fairey Gannet and the emphasis on the anti-submarine aspect of our naval air potential show that the lessons of recent history are not being neglected. The ordering of the night fighter Sea Venom lends further emphasis to the question of the training of the men who will crew with the pilots who may find themselves engaged in this specialized form of air warfare.

Formerly the naval observer went on a course of three months of pre-flight training, then three months at the Naval Air Signal School, followed by six months at the Observer School. Under the new system he receives the whole of his applied training at the Observer School, and in nine months. The reduction of the time by three months means intensified training and more work for both pupil and instructor. On the other hand, the pupil is saved the disrupting influence of two moves. The result of the new system is that already the speed and quality of output are both going up.

R.N. Air Station, St. Merryn (Captain A. S. Webb) is the home of the new system, and the Observer School (Lt. Cdr. A. R. Hallett, D.S.C., R.N.) has been expanded accordingly. The nine months observer course is divided into three parts of equal duration. Courses consist of 24 pupils, so that when divided into two watches they give a convenient unit for flying and ground instruction. The pupils are obtained from varied sources. They may consist of R.N. officers who have volunteered to specialize as observers; of officers on short-service commissions; of National Service officers; and of Dominion officers or ratings. In the near future the variety will be augmented by the picturesquely named upper yardmen (Air), drawn from all branches of the Navy.

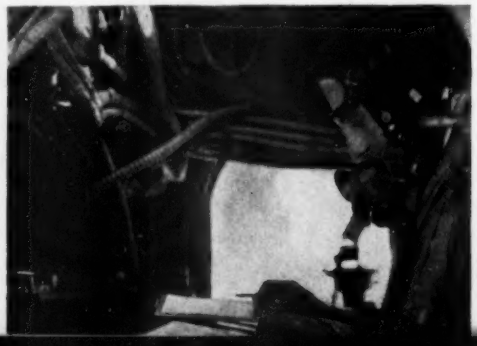
Part I, which the pupil joins on arrival, is the most academic—and generally the most strenuous—part of the whole course. In it he has to reach the same standard as his earlier-trained counterpart did on completion of pre-flight training and Naval Air Signal School. Physics, electrics and mathematics give a background to the aviation subjects and occupy the pupil each day until 1800hr. The flying during this part of the course is largely confined to teaching the operation of airborne radar and to a reasonable standard of H.F. W/T. operation. The pupil is examined and assessed at the end of Part I to ensure his fitness to continue with the succeeding stages.

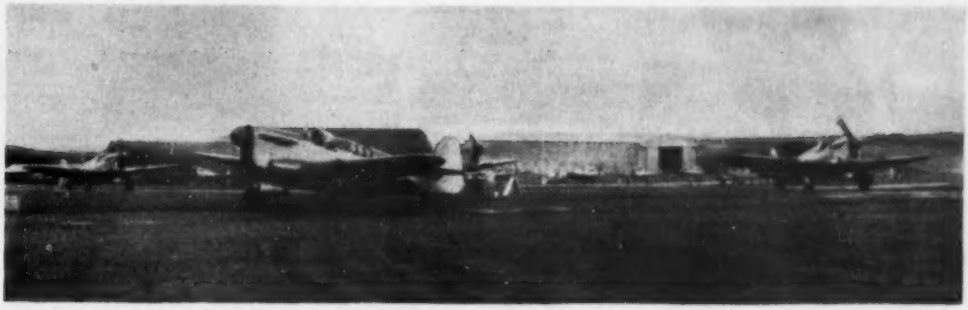
Part II is a three-month period in which the applied flying alternates progressively between navigation and H.F. W/T. day and night exercises, and the ground instruction is designed to prepare for the flying exercises.

In both these parts of the course, Anson "flying classrooms" and the Barracuda are used. These well-tried aircraft are supplied by No. 750 Squadron (Lt. Cdr. P. H. Fradd, R.N.). Both types are due to be replaced in the course of re-equipment, though in fact both still manage to cope with the duties demanded of them.

Part III represents a marked advance in the applied training. The pupil moves on to the Firefly T.3, in which he is required to navigate, maintain H.F. W/T. communications and use radar in a series of exercises which test his capacity to a high degree. The Firefly T.3 is extremely suitable for this stage, because the pupil, deprived of the moral support of a course-mate in the same aircraft, develops faster with the increased responsibility. No. 796 Squadron (Lt. Cdr. J. S. Barnes, R.N.) is responsible for supplying the Fireflies needed for this stage.

(Left) Less stimulating, but just as important, lecture-room instruction gives the pupil a sound theoretical background to his duties. (Right) With chart-board and Dalton computer—an observer u/t. in the severely utilitarian interior of a Barracuda.





In Part III of the Observer School course the pupils graduate to intensive—and extensive—practice in the Firefly T.3. At St. Merryn these aircraft—seen taxying out from dispersal for the day's duties—are provided by No. 796 Squadron.

A relatively high percentage of the hours flown by the observer under training are done at night. The achievement of any night-flying target tends to conflict with day flying and ground instruction, but that the task is demanded is recognition of the fact that the anti-submarine battle is, like all-weather fighting, very much of a round-the-clock operation.

The final assessment of the observer is made at a general instructors' meeting, at which the results of the formal examinations and of all individual air exercises are taken into account. Each of the latter is submitted to meticulous analysis throughout the course and is marked in conjunction with the pilot's report of the exercise. The finished product receives his observer wings and goes on to do his anti-submarine training at R.N. Air Station Eglinton. At this stage he is able to compete, by day or night, with all the navigational problems presented to the carrier-borne observer, operate airborne radar efficiently and maintain W/T. communication at 20 words a minute.

This represents the practical yardstick in the aviation rôle and achieving it represents a decisive goal. A less tangible but even more important requirement is to ensure that a good officer is sent to the Fleet, and the effort devoted to this end is by no means secondary to the aviation training. The Observer School is, in fact, an officers' training establishment in addition to its named function.

BRITAIN'S ATOMIC WEAPON

"A Classic of Co-operation" : Naval Aviation and R.A.A.F. at the Monte Bello Test

IN the House of Commons, on October 23rd, Mr. Churchill gave news of Britain's first atomic explosion, which took place in the Monte Bello islands on the morning of October 3rd. The object of the test, he said, was to investigate the effects of an atomic explosion in a harbour. Accordingly the weapon was placed in H.M.S. *Plym*, a frigate of 1,450 tons. Conditions were favourable and care was taken to wait for southerly winds so as to avoid the possibility of any significant concentration of radio-active particles spreading over the Australian mainland. Specimen structures of importance to Civil Defence and to the Armed Services were erected at various distances, and instruments were set up to record the effect of contamination, blast, heat flash, gamma ray flash and other factors of interest. The explosion caused thousands of tons of water, mud and rock from the sea bottom to be thrown many thousands of feet into the air, and a high tidal wave resulted. The effects of blast and radio-active contamination extended over a wide area and H.M.S. *Plym* was vaporized, except for some red hot fragments which were scattered over one of the islands and started fires in the dry vegetation.

Very soon after the explosion two Naval officers undertook the dangerous task of flying helicopters over the heavily contaminated lagoon where *Plym* had lain. Their task was to take samples of the water so that its radio-activity could be measured. After a longer interval scientists and Service personnel, in protective clothing, entered the contaminated area to examine the effect and recover records.

Mr. Churchill added that the weapon behaved exactly as expected and forecast in many precise details by Dr. W. G. Penney. "Scientific observations and measurements," the Prime Minister announced, "show that the weapon does not contradict the natural expectation that progress in this sphere would be continual."

When the flash first burst through the hull of *Plym* the temperature was nearly one million degrees and was, of course, far higher at the point of explosion.

Mr. Churchill expressed the indebtedness of Her Majesty's Government for the help received from Australia. Not only did the Australian Commonwealth allow us to use their territory for the test, but all branches of their Government—particularly the Navy, Army and Air Force—gave the most valuable collaboration.

Later, the news was given out from 10 Downing Street that the Queen had approved Dr. Penney's promotion to Knight Commander of the Order of the British Empire.

The Ministry of Supply has disclosed that Dr. Penney had as his deputy Dr. L. C. Tyte, of the M.o.S. Other key scientific personnel were Mr. W. A. S. Butement, chief scientist, Commonwealth Department of Supply and Development; Prof. L. H. Martin, of Melbourne University, chairman of the Australian Defence Scientific Committee; Dr. E. W. Titterton, Australia National University; and Dr. O. M. Solandt, chairman, Canadian Defence Committee.

Besides providing a small number of personnel for direct participation in the test, and three doctors for radiological medical work, the Royal Air Force provided air transport for personnel and material between the United Kingdom and Australia.

The base ship (*Campania*) carried a naval flight of five aircraft, comprising three Westland-Sikorsky Dragonfly 3 helicopters and two Vickers-Supermarine Sea Otter amphibians. The Dragonflies were provided to undertake particular duties in connection with the test itself but were also most useful for the transport of passengers and urgent stores between *Campania* and points ashore. The Sea Otters were supplied for air transport between the Monte Bello

A Royal Navy Westland-Sikorsky Dragonfly 3, of the type in which two officers undertook close-quarters reconnaissance of the test area shortly after the explosion.

Senior Commissioned Observer H. J. Lambert, D.S.M., who, together with Lt.-Cdr. D. T. J. Stanley, D.S.C., manned the Westland-Sikorsky Dragonfly 3 helicopters (Alvis Leonides engine) which collected samples of radio-active water.

(Right) Vickers-Supermarine Sea Otter amphibians (Bristol Mercury engine) also played a part. Their principal function was the transport of passengers and urgent stores.

BRITAIN'S ATOMIC WEAPON . . .

islands and the mainland. Royal Australian Air Force participation included the basing of seven Avro Lincoln bombers at a camp specially constructed at Broome civil airport.

It was learned after Mr. Churchill's statement that the Naval officers to whom he referred were Lt.-Cdr. D. T. J. Stanley, D.S.C., and — seen in the photograph above — Senior Commissioned Observer H. J. Lambert, D.S.M.

Almost coincident with the Prime Minister's statement, Air Chief Marshal Sir William Dickson, Britain's next Chief of the Air Staff, who is engaged on a round-the-world flight, said that Britain had started making atomic bombs and the aircraft to carry them. He added that, although there had been a great development in guided missiles, the push-button warfare era was not yet here. For ten years at least weapons would have to be piloted. Further reference to Sir William Dickson's remarks is made on the opposite page, and in our leading article.

FROM ALL QUARTERS

The Duke of Edinburgh at Cranfield

ON Wednesday of last week the staff and students of the College of Aeronautics, Cranfield, were honoured by a visit from H.R.H. the Duke of Edinburgh, who spent some five-and-a-half hours on a tour of the various departments, characteristically exhibiting a keen and knowledgeable interest in all he saw.

The royal visitor, who was received by Sir Edgar Ludlow-Hewitt (chairman of the governors), Sir Victor Goddard (principal) and Mr. V. F. Knight (registrar), first inspected the wind-tunnel laboratory, where he operated the control panel of the 9ft by 9ft supersonic continuous-running tunnel and saw the 8ft by 6ft general-purpose tunnel and others. Escorted in each case by the departmental head, the Duke then visited other departments and laboratories, including design, mechanical and structural test (in the latter laboratory he saw a resonance test of a dynamic model of the Boulton Paul delta wing), aircraft propulsion (including piston-engine, jet, compressor and ramjet test-houses), the flight department (where he saw the Dove "flying laboratory" and other College aircraft), aircraft economics and production (where a time-and-motion study of the assembly of Hercules pumps was demonstrated), and the electrical section.

Confirming the Conway

THE existence of a Rolls-Royce by-pass engine, designated Conway RCo.2, is now officially confirmed. This unit was the subject of a recent security leakage referred to in our previous issue.

Whereas in a simple turbojet the whole of the air is compressed, heated, expanded through the turbine and ejected at a high velocity, in the by-pass engine only a proportion is compressed and heated, the remainder by-passing the combustion system and turbine and rejoining the heated gases to mix with them and lower their temperature before the mixture is ejected at a relatively low velocity. This lowered velocity gives a higher propulsive efficiency and shows up in practice as a lower fuel consumption for any given thrust. Thus, the Conway should be specially suitable for long-range subsonic transports and bombers.

The Goodwill Mission

LAST week-end the four R.A.F. Canberras which are making a 24,000-mile goodwill tour of South and Central America and the Carribean area were already causing great excitement and interest among the people of major cities.

The mission is led by A.V-M. D. A. Boyle, A.O.C. No. 1 Group, piloting one of the Canberras in company with S/L. L. G. Press,

ROYAL VISIT: As related above, the Duke of Edinburgh visited Cranfield last week. The upper picture shows His Royal Highness at the controls of the supersonic wind tunnel; with him are Prof. A. D. Young, Mr. G. M. Lilley and Sir Edgar Ludlow-Hewitt. Below, he is inspecting a demonstration model of a project for swept-wing experiments (the test aerofoil is mounted vertically above the fuselage); also in the picture are WIC. C. G. B. McClure (back to camera) and Mr. C. F. Bethwaite.

who, as C.O. of No. 12 Squadron, which has provided the aircraft, is in charge of the flying. The four aircraft left Binbrook, Lincs, on Monday, October 20th, and flew first to Gibraltar and then on to Dakar, West Africa. On the 23rd they made the 1,965-mile South Atlantic crossing to Recife, Brazil, in 4 hr 19 min, which is equivalent to a speed of 455 m.p.h.

On Saturday last, the 25th, they went on to Rio de Janeiro, where, on arrival, they caused a sensation by flying fast and low over the crowded beaches in brilliant sunshine. Earlier three of the four were diverted to give a demonstration at Sao Paulo. Near the airport there, one of the aircraft was struck by a buzzard, which shattered the bomb-aimer's window.

The Canberras are being "mothered" by a servicing team from No. 12 Squadron; commanded by F/L. S. W. Pattinson, the party is travelling in two Hastings, which left Binbrook the day before the Canberras.

Contract for Japan

FIRST aircraft built in Japan since 1945, the Fletcher FD-25 Defender is to go into production at the Tokyo factory of the Toyo Aircraft Company for sale to non-Communist countries of the Far East. The FD-25 is one of America's "baby bombers" designed to carry bomb and rocket loads in close support of ground forces. The prototype (which was illustrated in our issue of August 8th last), together with the necessary drawings, have been cleared by the U.S. State Department for transfer to Japan.

Sir William Dickson in Australia

THE CHIEF OF THE AIR STAFF designate, Air Chief Marshal Sir William Dickson, who, as mentioned opposite, is making a world flight (to acquaint himself with Commonwealth and Western air defence before taking up his new post), said in Adelaide on October 25th that he had arrived there for an inspection of the Woomera rocket range.

Asked if Britain were prepared for air attack in the event of war, he said he was confident that any aggressor would meet formidable opposition; this was continually being improved by new control and reporting equipment. New "secret weapons" being tested at Woomera could be a first-line defence in air attack as well as weapons of attack, he added.

Air Chief Marshal Sir William Dickson is to confer with Mr. Robert Menzies, the Australian Prime Minister, before leaving Australia for Hong Kong and Japan on November 6th. His aircraft is a specially equipped R.A.F. Hastings.

Vandenberg in France

THE Chief of Staff of the U.S. Air Force, General Hoyt Vandenberg, has completed a tour of inspection of U.S.A.F. units in France. He expressed his satisfaction at the work of the French authorities in building NATO airfields, and disclosed that the 86th Combat Group, including 76 aircraft, would arrive in France in November. American jet fighters, he added, had possessed "atomic capability for some time." He did not know much about the capabilities of the British atom bomb, but felt that "a little more dissemination of information" would increase planning efficiency.

Air defence, General Vandenberg went on to say, would be at least as difficult as in World War II. However, it was believed that there was a possibility of an improved system of early warning. "It is going to take a little time to develop this, and quite a lot of money," he said, adding that the system needed a long testing period to make sure that the small additional defence capability was worth the increased expenditure.

Folland Light Fighter

THE directors of Folland Aircraft, Ltd., announce that the company has embarked upon the manufacture of a small military aircraft of a type "likely to lead to quantity production." It will cost much less than current large fighters, according to Mr. C. L. Hill, the chairman, who has informed the shareholders that it will have armament, equipment and flying qualities adequate for most of the operations which a single-seat fighter can perform, and an equal or better performance in speed and climb. The company are pushing ahead with the design as a private venture.

Folland Aircraft net profits for the year ending June 30th, 1952 —£173,282, before taxation—were again largely due to the company's position as a sub-contractor to the de Havilland Aircraft Co. for components of the Vampire, Venom and Comet. At June 30th there was an increase of more than £1 million in the value of orders on hand, compared with the corresponding period a year earlier.

FRONTIERSMEN: Picking up formation near their home base at North Bay, Ontario, these three Avro Canada CF-100 Canucks of the R.C.A.F. are used by an O.T.U. for the training of pilots and navigators, who will eventually serve with squadrons fully equipped with these all-weather intercepters. The name Canuck is now adopted by the R.C.A.F.

Brazilian Meteors?

AWAITED on Tuesday was confirmation of the signing of a contract for 70 Gloster Meteors (Mks 7 and 8) by the Brazilian Air Ministry. A report from Rio de Janeiro, however, states that the £5,769,230 contract has been approved by President Vargas.

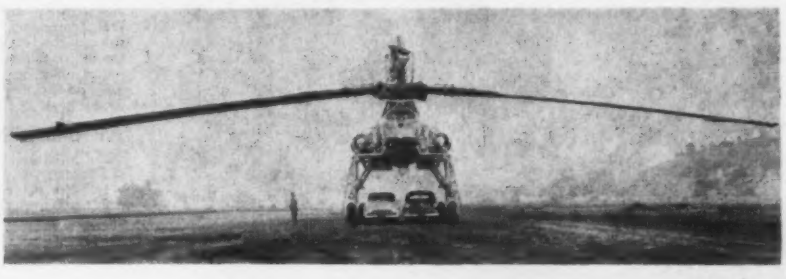
The Paris Show

FROM Paris it is announced that the 20th International Aeronautical Exhibition will be held from June 26th to July 5th, 1953. The venue is announced as Le Bourget Airport, and it is believed that, for the first time, the Grand Palais will not be used at all; the aircraft will be displayed at Le Bourget and demonstration flights made—though on nothing like a Farnborough scale.

Top Notch

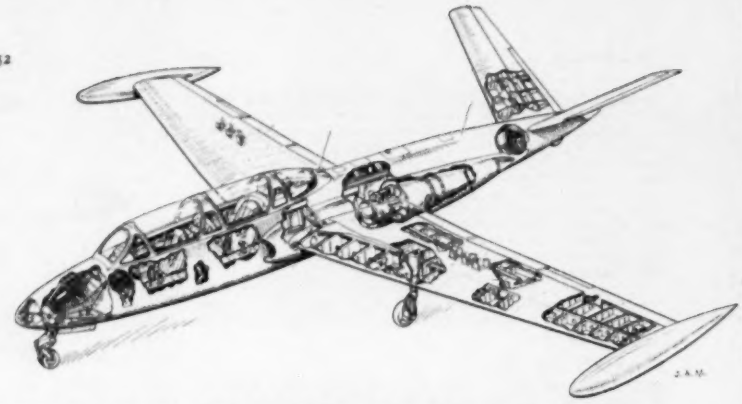
GOODWILL and prestige cannot readily be measured, but B.O.A.C. have in every Comet passenger a potential salesman. It is gratifying to learn that the editor (who is also the publisher) of *American Aviation* was recently able to fly by Comet to Singapore; in his journal he writes: "If I have had any doubts about commercial jet, those doubts have been dispelled thoroughly. In some hundreds of thousands of miles of flying throughout the U.S. and the World, this Comet trip has been tops by a considerable margin . . . All in all, this writer can but conclude that jet transport is wonderful, it has everything claimed for it, and can't help but be a big hit with the public."

Another recent appreciation of the Comet is worthy of mention. A 16-year-old girl, Gillian Poole, was taking part in a teenagers' discussion on B.B.C. Television last week. She gave it as her opinion that, if she had only 24 hours to live, the experience she would most like would be a flight in a Comet. Sir Miles Thomas, B.O.A.C.'s chairman, happened to be watching the programme. Touched by her enthusiasm ("It's the most exciting thing I can think of," she had said) he forthwith gave the generous order that she should be given a ride during a crew-training flight.



TWO CARS stand comfortably between the "fourposter" undercarriage legs of the Hughes XH-17 rotor-plane—and the enormous machine is in fact designed to lift them (or almost any equivalent military load) without difficulty. The XH-17—which has a rotor-blade span of 125ft —recently made its first untethered flight. Another photograph, and a news item, appear overleaf.

HERE AND THERE



MAGISTER: So named (a little confusingly while the well-known Miles type still remains in service) is this French Fouga CM-170R light jet trainer, now well advanced in its tests. Powered with two Turboméca Marbores, it is said to have surpassed its constructors' performance estimates, particularly in rate of climb, take-off run and landing speed. The calculated level speed, between sea level and 30,000ft, was 370-430 m.p.h. Two specimens are in existence.

Starfire's Record

A LOCKHEED F-94C Starfire, carrying an operational crew of two, has set up a new U.S.A.F. cross-country record on a flight from Los Angeles to Panama City. The distance of more than 2,500 miles was covered in 3 hr 50 min, at an average speed of over 600 m.p.h., and a spokesman of the U.S.A.F. has announced that the machine flew at "supersonic speed" for most of the distance. The Starfire made two refuelling stops.

The R.A.A.F. Neptunes

TWO more Neptunes arrived in Australia from America recently in charge of R.A.A.F. crews and will be stationed at Perth, W.A. This makes a total of four Neptunes now in Australia; deliveries are to be made at the rate of two or three per month until the end of the year.

Prince Bernhard's Air Tour

ACCEPTING an invitation from the Government of Ecuador, Prince Bernhard of the Netherlands is to extend his South American goodwill visit to include a journey in that country. The journey, to be made in the K.L.M. charter DC-4 *Schiedam*, will begin early in November. The Prince and his suite will leave Bogota, Colombia, on November 10th, and the stay at Quito, Ecuador, will last until November 14th. Also on board *Schiedam* will be Dr. A. Plesman, K.L.M.'s chairman, and Mr. P. F. S. Otten, chairman of the Philips concern at Eindhoven. It may be assumed that Prince Bernhard, who holds a number of licences for commercial and other aircraft, will do much of the piloting.

Dutch Naval Helicopters

IN addition to the two Westland-Sikorsky S-55 helicopters which K.L.M. plans to operate on internal services in Holland (and possibly in New Guinea) next year, the Dutch Royal Naval Air Service is to get some S-55s from America. They will replace the Sea Otters now being used for air/sea rescue work.

Fairey Capital Increase

PLANNING to double its borrowing powers—to over £4 million—the board of the Fairey Aviation Company has called an extraordinary general meeting for November 13th in London. The proposed new borrowing limit is four times the issued and paid-up share capital, at present £1,027,750.

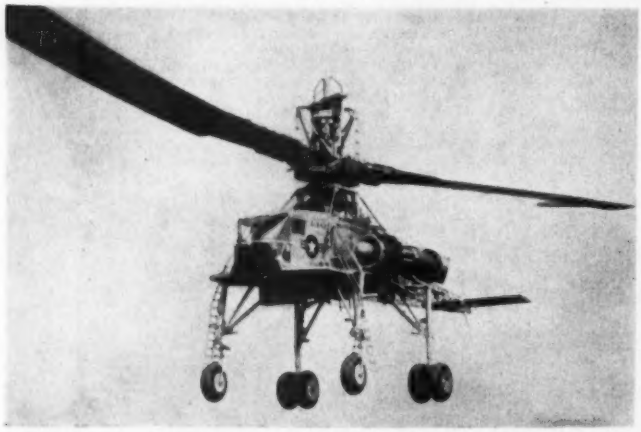
Women's Team for N.Z. Race

THERE is still little news of firm entries for the England to New Zealand Race. From Australia comes a report that Mrs. Gertrude McKenzie (hon. secretary of the Victorian Division of the Australian Women Pilots Association), Miss Freda Thompson (who flew a Moth to Australia in 1934 and also flew to New Guinea recently) and Miss Constance Jordan are forming a women's team for the contest. They hope to secure an Avro Anson Mk 20 and take part in the handicap event.

Mig Toll

IN the House of Lords last week, Earl Alexander, the Defence Minister, said that the Communist air forces in Korea continued to grow. Some 1,200 Mig-15s were now available, compared with the "1,000 jets" to which he had referred last May. United Nations pilots, however, had recently had notable successes against the Migs. In August and September some 200 of the enemy fighters were destroyed or damaged; 60 were destroyed in September alone. Losses in air combat were ten to one in our favour.

THE THING: In free flight at last, on October 23rd at Culver City, California, the vast Hughes XH-17 rotorplane fairly bristles with massive features more suggestive of civil than of aeronautical engineering. The rotor hub assembly, for example, must be nearly 20ft high, and the stalky under-carriage allows an unobstructed space beneath the belly for cargo.



A Crane Flies

MORE like the proverbial "flying bedstead" than anything else now flying, the giant Hughes XH-17 helicopter has carried out its initial free-flight trials. Intended as a military weight-lifter for short-haul transport of front-line stores, and for giving assistance in bridge-building, the XH-17 is powered by two General Electric J-35 turbojets, the compressor delivery from which is mainly ducted straight to the two huge rotor blades. This airflow then provides tip drive by feeding rotor burners; the remaining compressor air passes through the J-35 burners and turbine. The rotor-disc diameter is 125ft, and the "four-poster" landing gear is largely responsible for the helicopter's overall height of 50ft—probably an all-time record.

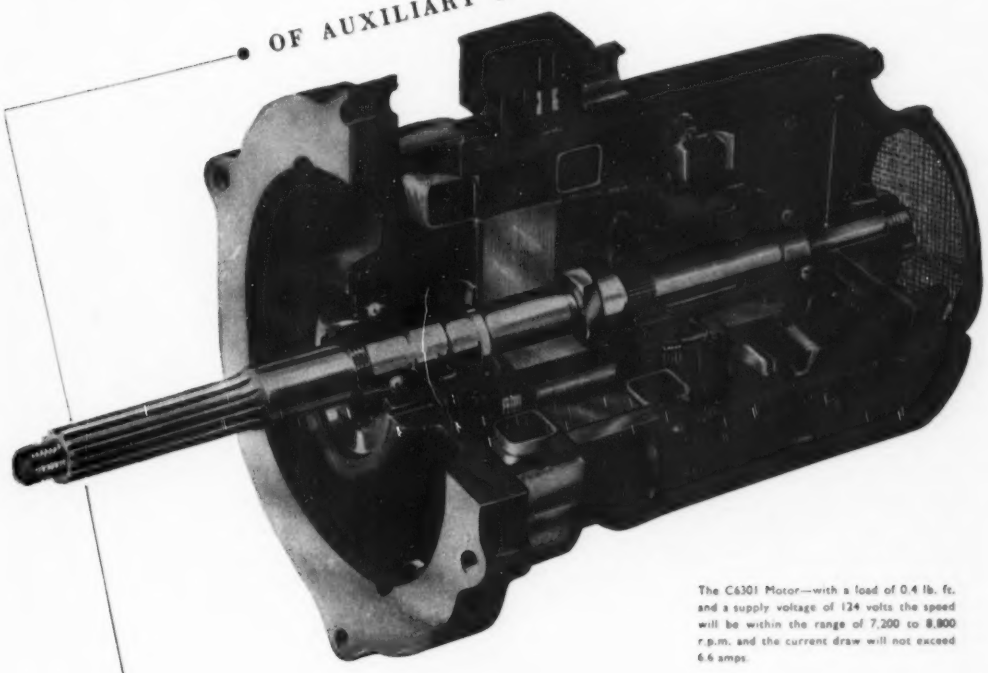
T.V. Interception?

TELEVISION broadcasts from a station at Rochester, N.Y., are the suspected cause of crashes of radio-controlled target aircraft flown by the R.C.A.F. from Deseronto, Ontario. Five of the targets, valued at $3,000 each, have recently been destroyed,

THE ELECTRICAL ASPECT

REMEMBER POPPY DAY

OF AUXILIARY POWER IN AIRCRAFT



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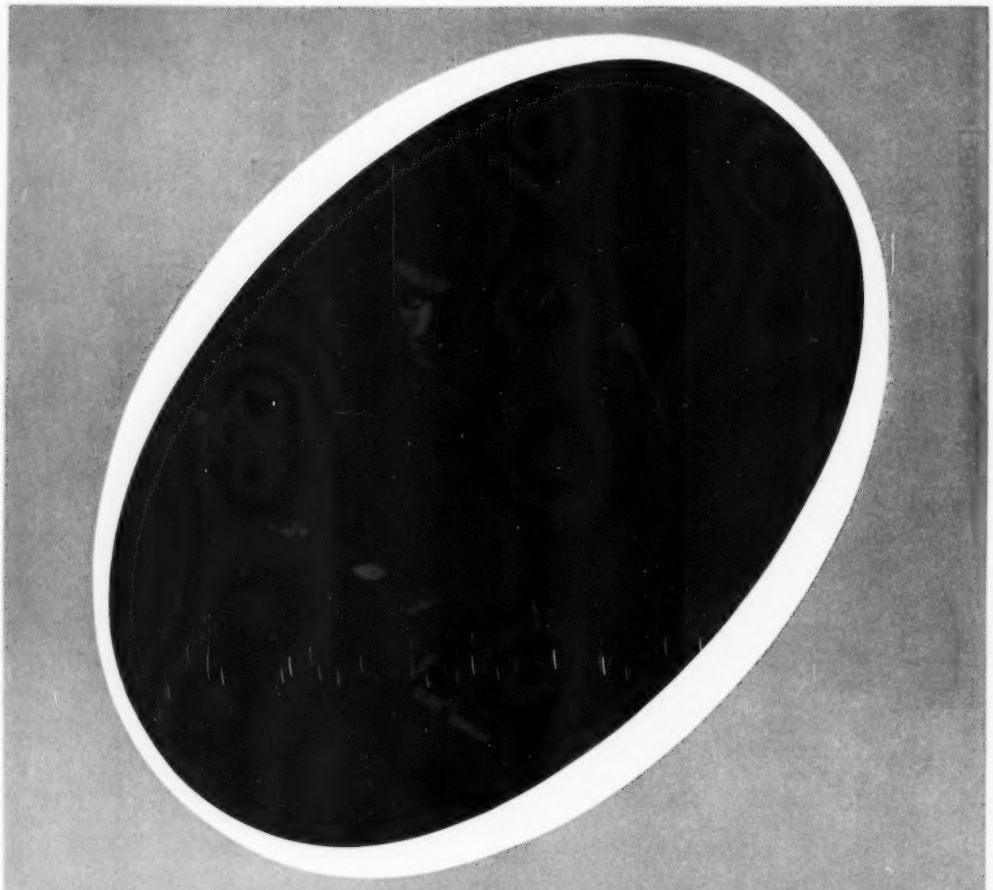

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HERE AND THERE . . .

in spite of the fact that they are equipped with parachutes which come automatically into action should radio contact be lost. The manager of the television station has denied that its signals could reach the Deseronto area, which lies about 60 miles distant, on the northern side of Lake Ontario.

Whittle Mk 2

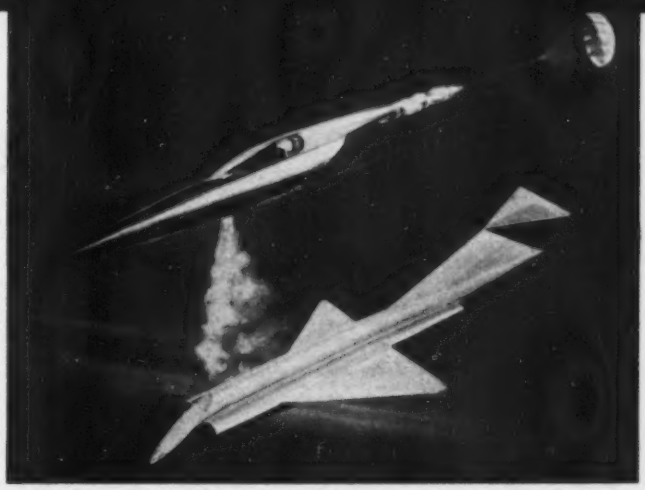
THE youngest student pilot being trained by the Midland Aero Club at Elmdon is 17-year-old Ian Whittle, son of Air Commodore Sir Frank Whittle. After four years in the cadet force of Rossall School young Whittle won a £150 Air Ministry scholarship—which will pay for his tuition to Private Pilot's Licence standard, lodgings during the course, and other expenses. He recently made his first solo—in a Tiger Moth—and a cross-country flight.

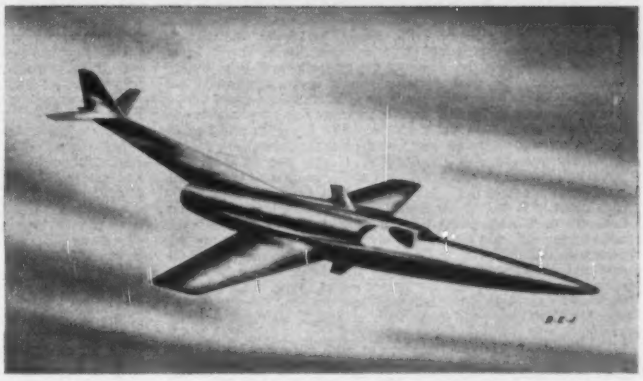
A Manner of Speaking

IN the Commons on October 15th, Mr. Frank Beswick (Lab., Uxbridge) asked what steps were proposed to enforce the use of the new civil aviation phonetic alphabet, which had been rejected by both the British and international airline pilots' associations. Mr. Reginald Maudling, Parliamentary Secretary to the Minister for Civil Aviation, said no steps had been taken; but it was much to be hoped that the airlines and aircrew would collaborate in giving the new alphabet a thorough trial. Mr. Beswick took this reply to mean that the Ministry were not going to enforce it; "would it not be best," he said, "to take this silly alphabet away and have its phonetical throat cut?"

Douglas X-3 Flies

OCTOBER 20th was the date of the first flight of the Douglas X-3 research aircraft for the U.S.A.F., successor to the U.S. Navy's Skyrocket, which, flown by test pilot Bill Bridgeman, achieved a speed of at least 1,238 m.p.h. Bridgeman was likewise the pilot on the first flight of the X-3, concerning which the U.S.A.F. announce: "Every effort is being made to protect the security of this plane, which will play an important part in advancing U.S. air power." While the artist's impression on this page is believed to be substantially accurate, it is known that 60 separate design-studies were made after the contract was placed in 1947. The turbojet is believed to be a Westinghouse J-40, the tailpipe of which is designed to function as a ramjet at supersonic speeds. Stabilizing fins are fitted above and below the fuselage to damp the violent oscillations such as were experienced by the Skyrocket.





X-3: So designated is the new and highly secret Douglas research aircraft referred to on this page. The artist's impression immediately above is believed to be substantially correct. Uppermost is a Douglas drawing of an escape capsule for a high-speed aircraft of unspecified type.

BON VOYAGE PARTY: Representatives of the Latin-American countries met at Canning House, London, to say farewell to the R.A.F. goodwill mission now touring South America in four Canberras and two Hastings. In this picture are (l. to r.) Don Manuel Bianchi, Chilean Ambassador; S/L. L. G. Press, in command of the flight; and Don M. Errazuriz, Chilean Air Attaché.

IN BRIEF

THE United Steel Companies, Ltd., have produced an illustrated booklet describing how they recruit candidates—mainly from within their own organization—for senior staff appointments, and the methods by which those selected are trained.

* * *

As from October 27th, the David Brown Companies have acquired the first floor suite of 96, Piccadilly, W.1 (Grosvenor 7747), as their new London headquarters. For the time being the London office of David Brown Tractors, Ltd., will remain at 49-50 Avenue Chambers, W.C.1.

* * *

At the recent annual general meeting of the National Union of Manufacturers, Mr. C. S. Carland, A.R.C.S., D.Sc., F.R.I.C., M.I.Chem.E., chairman of Stream-Line Filters, Ltd., resigned the office of honorary treasurer after 27 years. He was elected a vice-president.

* * *

A new British Standard, No. G.131, "Lead/Acid Batteries (Non-aerobatic) for Aircraft," has been published by the British Standards Institution; it is a revision, providing for high-discharge-rate batteries and an alternative terminal arrangement. Copies are obtainable at 2s. from the B.S.I. sales branch at 24 Victoria Street, London, S.W.1.

* * *

At the annual general meeting of the Aluminium Castings Co., Ltd., due to take place at Glasgow today, October 31st, the chairman's address will inform shareholders that, in addition to the manufacture of gas-turbine "canware," Burnley Aircraft Products, Ltd., have received substantial contracts for the repair and servicing of these components. The company is one of the ten members of the Aluminium Castings group.

THE VIKING

Detailed History, from B.E.A. and other

THE development of the Vickers V.C.1 Viking in service with B.E.A. makes a story that is well worth recording, even in these days of rapid advances in the operation of British turbojet and turboprop transports. Designed as an interim-type aircraft to fill the immediate post-war gap, the Viking was the first British post-war transport to go into service, and a glance at its six-year record is now due.

It is a far cry from the first 21-seat Viking of 1945, with fabric wings, to the 38-seat *Admiral* class of 1952, and much has happened to the aircraft and to factors such as its overhaul life and annual utilization between these dates. An attempt to describe every modification made during the Viking's life with B.E.A. would be of little value: this article, therefore, refers to specific aspects of the Viking's development, and gives a general account of the *Admiral* conversion, with examples of detailed changes particularly relevant to the story.

The introduction of the Viking into B.E.A. service came at the same time as the Corporation itself was developing, almost from scratch, its route network and operational method. The absence of a tried system of new-aircraft introduction, together with the lack of operational data on the Viking from any other airline, made this early period especially difficult, and extended the time taken up by it. Direct costs were increased by the inevitable low utilization, lack of maintenance experience, inefficiency of a small initial fleet, training of crews and ground personnel, and miscellaneous unknown operating factors. In addition, the indirect costs of project and development engineering, and planning of maintenance, traffic, commercial and flight operations aspects (all normally present when any new type is introduced), had swollen rapidly at this time, owing to the expansion of these departments to do this introductory work. This should be borne in mind when considering the following particular phases and aspects of the Viking's airline life.

Early Flight Tests.—In April 1946, at the request of B.E.A., the third prototype Viking G-AGOM was delivered to the development flight of B.O.A.C. for handling trials. The first production machine, G-AGON, was delivered for the same purpose the following month, and a complete investigation was made into the operational suitability of the aircraft and its radio equipment, its handling and maintenance features, and its performance. Both machines were of the Mk 1A "short-nosed" type, with geodetic fabric-covered mainplane, tailplane and fin, and Hercules 630 engines; G-AGON was fitted with a T.K.S. airframe de-icing system.

The handling trials included 73 hr and 37 hr respectively on the prototype and production model, during which every aspect of the aircraft's performance was thoroughly examined. On G-AGOM, after test instruments had been fitted, checks on general handling, climb performance and speed/power consumption variation were the first to be made, followed by V.H.F. signal range tests, and maintenance check 2 (the 25-hr inspection). Airscrew vibration checks, single-engine handling and night flying were then followed by tests of catering equipment, vibration, noise and booster-pump utilization, and the machine was re-weighed at Boscombe Down. After D/F. loop calibration and swinging, and tests of take-off, rated and maximum cruising power, the 100-hr maintenance check 3 was carried out, and the Viking was returned to the makers. After a similar but shorter period of test flying and appraisal, the second machine, G-AGON, was delivered to the aircrew training school at Aldermaston.

Following these trials, modifications prior to the aircraft's operational use were suggested, some believed essential before delivery, others desirable subsequently. Thirty-seven modifications were recommended to improve maintenance, together with eight essential and 33 desirable changes to the aircraft equipment (excluding radio) from an operational viewpoint. Eleven faults in the cockpit layout, and 17 essential and 63 desirable changes in the radio equipment, were also reported.

The De-icing Problem.—The first major problem in the operation of Vikings arose in December 1946, and was concerned with ice accretion on the tailplane. At this time 12 aircraft (Mks 1A and 1) were in service on eight European routes, and a further six were being used for training. On December 4th, a B.E.A. Viking 1 developed an overbalanced elevator when a moderate accretion of ice occurred on the tailplane leading edge, and more serious overbalancing occurred with ¼in of rough ice during a test flight the following day. B.E.A. decided to withdraw the Vikings from service and, in co-operation with Vickers-Armstrongs, to carry out a most extensive series of flying tests in severe icing conditions. There were two problems: (a) to ensure that the de-icing equipment could prevent ice from forming and could remove any ice which had already formed; and (b) to improve the handling characteristics of the aircraft with ice on its surfaces. As Mk 1A machines had carried ice without any change in elevator control arising, it was thought that some change in elevator balance had been introduced with the metal tailplane of the Mk 1.

Wind-tunnel tests confirmed that the basic elevator without ice was too closely balanced, and this aerodynamic problem, being the more important, was tackled first. Suggested solutions were spring-tab modification, cusped trailing edges, built-up trailing edges and modified horn balances. The tab gearing was increased, and 5/16in tubing was added to top and bottom surfaces of the port elevator; but the most significant improvement was due to the reduction and increase of the port and starboard elevator horn balance areas respectively. Even on the earliest Vikings the port horn balance had been smaller than the starboard, due to the destabilizing effect (on the port side) of the asymmetric slipstream; but by reducing its area still further—to 62 per cent of the original—it became completely shielded and was in effect a mass-balance arm only. With the above modifications (and a spring-compensator giving an elevator down-force of 25 lb, fitted temporarily until the starboard horn balance was further increased), improvements in longitudinal stability and elevator hinge moment linearity were achieved.

During January and February 1947, an exhaustive series of flight tests were carried out, in order to study handling characteristics under icing conditions and the effects of varying the rate of flow of the de-icing fluid. Capt. J. W. G. James, then B.E.A.'s chief pilot, and now their director of flight operations, was the pilot in charge, and he was accompanied on the flights by other experts from B.E.A. and Vickers-Armstrongs, including Mr. George Edwards, the constructors' chief designer.

Areas of heavy icing were sought, and elevator damping tests with de-icing equipment switched off showed that the behaviour of the aircraft was satisfactory, both on one and two engines, and when landing. The rates of flow of de-icing fluid used previously proved to be insufficient to prevent ice forming on the tailplane; and an increased emergency rate was adopted until optimum rates could be subsequently determined. The main conclusion from the tests was that the Viking, as modified, was safe under icing conditions; the question of the rate of flow of the de-icing fluid was obviously not confined to the Viking alone, but concerned, in addition, other types of aircraft.

The modifications mentioned above were made to all B.E.A.

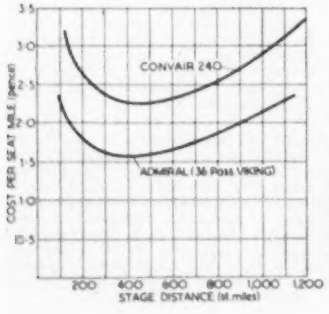
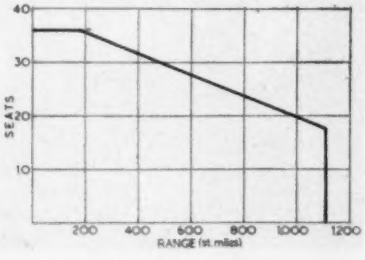


Fig. 1 (left) "Aircraft costs" per seat mile, assuming 2,000 hr utilization. These costs correspond broadly to direct operating costs, and represent in this case between 45 and 50 per cent of the total cost.

Fig. 2 (below) Passenger capacity variation with range for the "Admiral," assuming fixed fuel reserves, two-crew operation (plus steward) and the 36-seater arrangement; 38 passengers could in fact be carried over the short-distance routes.



in OPERATION

Sources, of the Working Life of a Notable Fleet

Vikings, and the type returned to service during the summer of 1947. At about this time arrangements were made to replace the 21-seat Mks 1A and 1 by the Mk 1B, which would carry 24 seats. The new version had a 28in extension to the fuselage, which gave aerodynamic, as well as economic, improvement. Further de-icing trials, to determine the optimum rate of flow of the T.K.S. fluid, were made between 1947 and 1950.

Route Expansion.—The first scheduled Viking service was flown by G-AHOP, a Mk 1A aircraft, to Copenhagen, on September 1st, 1946, and as mentioned, 12 were in service when the de-icing trouble occurred later that year. From April 1947, the Viking 1Bs began to replace the Dakotas flying on the Corporation's main European runs, although route-expansion for both types was limited at this time by the lack of radio aids on the continent. Before the introduction of the Viking on a particular route, a full series of proving flights was carried out, to study in detail the route facilities available and to determine the most suitable operating procedures for that route. In May, 1947, the first proving flight to the Mediterranean was flown, from Northolt to Ankara, *via* Marseilles, Rome, Naples, Athens and Istanbul. The facilities at these main airports and at the proposed diversionary airfields were investigated, each sector being closely studied. Tracks, safety heights, timetables, radio aids and their behaviour, airport control standards, aircraft performance and refuelling efficiency—and indeed every other relevant detail—were checked by the specialists and the crew. The results being satisfactory, Vikings began to operate on these southern routes.

Similar proving flights to Frankfurt, Prague, Paris, northern Europe, Scandinavia, Spain and Portugal were followed by the introduction of the type on these routes. In less than two years from the Viking's introduction in 1947, the type was flying on practically all B.E.A.'s continental routes. An exception was the flight from London to Fornebu airport, Oslo, where short runways made economic Viking operation impossible. For the same reason other aircraft were used on the majority of domestic routes, Vikings being flown on the trunk U.K. routes only.

Airframe Development.—The original version of the Viking (developed from the war-time Wellington) was the Mk 1A, with fabric-covered geodetic wings and tailplane, of which three prototypes and 19 production models were constructed. Of these, the M.o.S. received the first two prototypes, and B.E.A. the remaining prototype and all the production machines (G-AGON, the first of these, was received on May 10th, 1946). This version was followed by the Mk 1, with redesigned metal-covered wing and tailplane structure, 14 of which were built, nine going to B.E.A. The 1As and 1s were received by the Corporation during 1946. The main external change in the appearance of the aircraft then occurred; the forward fuselage was extended by 28in, bringing the c.g. forward and enabling three extra passengers to be carried. This type was known as the Mk 1B, and became the standard civil version; B.E.A. received 44, and the remaining 70 (this total excludes a machine experimentally powered by Nene turbojets) went into service with many of the world's other airlines, charter firms and governments.

The icing trials of the Mk 1s in 1946-47, and the subsequent airframe modifications, have already been mentioned: during the spring of 1947, the 1As and 1s of B.E.A. started to be replaced by the 1B, deliveries of which started in April, 1947, and continued until 1949. With the introduction of this version, the story of the Viking's airframe development becomes, as with the engines, one of gradual progress by means of numerous modifications towards improved performance and greater reliability: no major change occurred until the *Admiral* conversion, referred to later. Among the many modifications were improvements in the fuel system and radio and electrical fittings; removal of the dinghy stowage; re-routing of the water system to the galley; the use of more suitable types of rivets; the fitting of liners to the control rods; and the changing of the windscreen-wiping equipment. It may be added that two modifications published during the same month called for (a) the labelling of "emergency exit" signs in French and German, and (b) an increase in the capacity of the Elsan equipment.

On the maintenance side, inspection periods and component-overhaul lives have been increased, without reduction of the standard of safety. Although the Viking was not designed for planned maintenance by component-change, this method has in fact been adopted, and with an overall increase of efficiency. Maintenance man-hours per flying hour have been steadily reduced. As a safety precaution, the lower spar-booms of the centre section are now changed at 8,000 hr (or examined and used up to 10,000 hr with intermediate periodic checks), and the engine nacelles are also changed at this time. The approved lengthening of inspection periods is shown by the following figures :—

1947 Check No.	Period	Equivalent 1950 Check	Period
1	Daily	A	Pre-departure
2	25 hr	1	60 hr
3	100 hr	2	255 hr
3A	200 hr	3	510 hr
4	400 hr	4	1,000 hr

Note: At Check 4, a section C. of A. inspection (one of four) is performed, and an engine change is made. The increase in periods between Checks 4 therefore depends on the engine life.

Engine Development.—The engines fitted to B.E.A.'s early short-nosed Vikings had been the Bristol Hercules 630, with a nose exhaust-collector ring; but with the change to Mk 1B aircraft in 1947 came also a change of power unit—to the Hercules 634, with the present exhaust system of rearward-leading pipes to twin outlets. Perhaps the most noticeable aspect of the engine development has been the progressive increase in the number of hours (approved by the A.R.B.) between complete overhauls (Fig. 3). Life is seen to have increased in steps from 400 hr when operations began in 1947 to 1,250 hr at present—an increase of some 212 per cent. Each step has been preceded by the experimental running to the higher figure of six engines, one fitted to each of six line-aircraft; examination of the stripped engine at overhaul; and, where necessary, modification until the engine condition is satisfactory.

During the operational life of the Hercules engines with B.E.A., continual modification and development has taken place. Although this development has taken place in practically all parts of the engine, an example of the improvement is given by the reduction in the number of defects occurring in the exhaust system, which has decreased from approximately 200 per month in the early days to 12 per month at present, achieved by modifications in fittings and improved design.

In this, as with the engine as a whole, development work has been shared between B.E.A., Vickers-Armstrongs, and Bristols. The number of premature engine removals, also, has been lowered

Increased payload has been made possible with the recent introduction of Admiral *class Vikings, capable of carrying 38 passengers. Here seen at Northolt is R.M.A. Lord Fisher, the first of these aircraft; it is now operating on the London-Paris tourist service.*

THE VIKING IN OPERATION . . .

steadily—an achievement particularly commendable in view of the extension of engine overhaul life—this year's figure being only half of that last year. One interesting modification developed with Bristols was the introduction of four small bar-magnets—at each end of the Bristol oil filter—to retain fine ferrous particles which might otherwise circulate and damage the engine. The appearance of these particles in the filter was often the only indication of wear or failure of an internal component, and was not always shown up by the gauze mesh alone, owing to the small size of the particles.

The majority of the airscrews used with the Hercules engines have been of Rotol type. Some hub defects were encountered at one stage, but were overcome, and the overhaul life of the airscrews has increased from 500 hr in 1947 to 1,650 hr at present.

Changes in the operational cruising power of the engines had been made, based on the results of strip examination during overhauls, in order to assist in lengthening the overhaul life. The maximum permissible cruising power, at one time 1,000 b.h.p., has been decreased to 850 b.h.p., with normal cruising flight scheduled at 770 b.h.p. A final comparison of figures reflects the increased Viking fleet utilization, which itself is due in large measure to increased engine reliability—the average number of hours flown per month per engine, which in 1948 was 100, is now 550.

Radio Development.—Intensive development of the radio equipment fitted in the Viking was necessary during service for two main reasons: (a) when the aircraft had been originally planned, little was definitely known about the future development of air-traffic control in Europe; (b) the only radio equipment available at the time had been designed for military use, with little thought for an airline's maintenance and weight problems.

The resulting development-work was tackled by radio experts of B.E.A.'s flight operations and project and development branches, one of whose first problems, in 1946, was the lack of accurate ground navigational aids. European coverage by the Gee system was incomplete, and few facilities existed for blind approaches. For the longer Viking routes, new equipment, enabling holding patterns to be flown over M.F. beacons, and navigation along radio ranges, was soon found necessary. An SCR.269-G radio compass was consequently fitted, the best position of its D/F. loop aerial as regards accuracy and ease of calibration being found above the forward passenger cabin, rather than beneath the fuselage, as had been the American practice.

During the winter of 1947, crews reported the reception of musical and vocal interference while using the R.1598/1599 command beam-approach equipment: the cause was traced to B.B.C. television sound transmissions from Alexandra Palace, over which a certain approach path passed, and successful modification of the airborne receiver to improve selectivity and so remove the interference was carried out. Later the same year, transmissions from the manually tuned T.1154 M.F. set were reported by ground stations to be affected by frequency drift: in co-operation with Marconi, Ltd., B.E.A. introduced a form of crystal stabilization to correct this tendency.

Likelihood of damage to the STR. 12A/1 V.H.F. equipment in certain weather conditions by electrical discharge from the atmosphere (lightning-strikes) has been reduced by means of an "earthed matching stub," effectively earthing the aerial while retaining its radio efficiency; and the phenomenon of precipitation static, the charge generated on the aircraft during its flight through the air, has been controlled by the addition of wicks to the trailing edges and, recently, of discharge rods to the wing-tips.

With the widening of the air-traffic-control pattern, the initial number of four channels on airborne V.H.F. equipment had proved inadequate, and in 1946 the M.o.S. had issued specifications for development of equipment having 12 channels. A further assessment, in the following year, showed that no fewer than 19 channels would be required before the M.C.A. airways scheme could be introduced, and subsequent modification performed by B.E.A. in co-operation with the radio manufacturers was successful in raising the number of channels to 23.

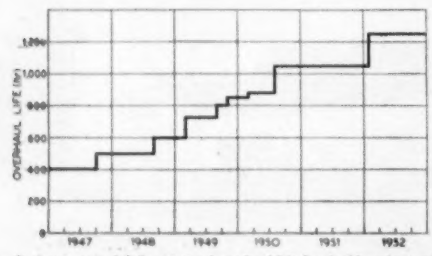


Fig. 3. Increase in A.R.B.-approved overhaul life for the Hercules engine. Before each increase, trial extensions on six engines in service on "line" aircraft were made.

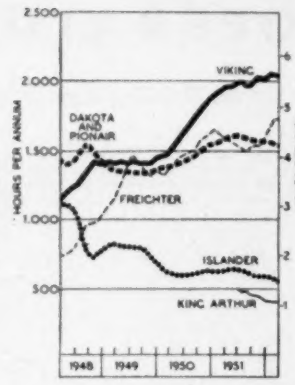


Fig. 4. Average aircraft utilization (revenue flying hours per annum) for B.E.A.'s various aircraft types. The progressive improvement and currently high value of the Viking figure are made apparent.

The most recent major change has been the installation of I.L.S. equipment, shown to be necessary by operational experience, in the Viking.

Among the many other developments in the Viking's radio equipment have been the re-siting of aerials to prevent mutually induced voltages, and their modification to reduce icing trouble (the Corporation's Vikings are shortly to be fitted with suppressed aerials); the improvement in construction and mounting of radio valves to overcome vibration effect; the use of filters in the microphone circuit to cut down background noise and improve R/T. intelligibility; and weight reduction and general improvement in the actual headsets and microphones used. From this work on the Viking, also, valuable design experience has been gained, leading to increased standardisation of radio equipment and improved layout in later types.

Performance Standards.—During 1946, as B.E.A. was taking delivery of its first Vikings, the provisional International Civil Aviation Organization was discussing the question of operating performance standards for civil aircraft. In the absence of agreed international standards, B.E.A. drafted and applied its own performance requirements for Vikings. Subsequently, I.C.A.O. recommended standards for "category A" aircraft whose Type Certificates of Airworthiness were obtained later than 1947, but allowed individual states to lay down their own performance requirements for earlier types of aircraft, which would not normally be expected to satisfy the more rigorous "category A" demands. The operating standards required of Viking-type aircraft by the M.C.A. in this country were, in fact, exceeded by those of B.E.A., which demanded an adequate rate of climb *on one engine* to clear obstacles after take-off, and *complete* temperature accountability. (Corresponding M.C.A. provisions had been for climb on both engines, and the effect on take-off power of only those temperatures which were greater than I.C.A.N.+15 deg C.)

The implementation of these standards involved a detailed examination of all terminal and alternate airports used by B.E.A., and in some cases the restriction of take-off weight due to the short take-off distance available or to obstructions in the take-off path. The extent of this restriction was reduced with head-winds or decreased temperatures, which, in addition to factors such as the airport elevation, and runway condition and slope, were taken into account in the analysis.

The need to control the operation of the Viking by reference to its performance raised the question of exactly what this performance was. Performance figures from the production flight-tests were admittedly available, but in what manner had the performance of individual aircraft deteriorated during service? For the first time by any airline, the performance of all the aircraft in the fleet was measured, in an attempt to answer this question and so discover the characteristics (e.g., distribution curve of performance values, mean performance, deviation from the mean) of the fleet as a whole. These measurements, of cruising speed and single-engined rate of climb at maximum rated and take-off powers, were begun in 1948 as an addition to the annual flight tests for C. of A. renewal, and have been repeated on all such occasions since that date. They have enabled the variation in performance due to age of the aircraft and to increase in engine overhaul life to be studied, and sub-standard performances to be discovered. As examples of the

A de Havilland Announcement

OPPORTUNITIES AT HATFIELD

Interesting Vacancies in the de Havilland Advanced-Project Teams

Scope and Security for Top-Grade Technicians

FAR-REACHING development plans have called for further considerable expansion of the de Havilland technical team.

Technicians who combine top-grade qualifications with a high degree of enthusiasm and vision are required immediately for key posts in work on advanced projects.

The de Havilland Aircraft Company is chiefly interested in people with first-class knowledge and experience, who can command a high salary and can make their own particular mark in aeronautical development. The appointments will be permanent, progressive and pensionable.

INTER-RELATED WORLD TEAMS
It is well known that one of the bases of continued success of de Havilland products is the close co-operation between teams of technicians and operating specialists working in different parts of the world. Thus the de Havilland technician has unrivalled opportunities to widen his own scope and outlook by acquiring at first hand knowledge of technical development and operating conditions throughout the world.

In this connection it is worth stressing that the de Havilland Enterprise is the only organisation of its kind which designs and constructs military and civil aircraft, guided weapons, jet, rocket and piston engines and propellers.

ADVANCED PROJECTS: With the world's first jet airliner, the Comet, now building up to full production and the first stages of the conquest of supersonic speed passed, the Company is entering upon a new phase in its programme of work on civil and military aircraft. A whole new field of aeronautical development is now open, and for technicians able to play an effective part in a team working on many aspects of advanced design, the opportunities for real achievement—as well as for progress and promotion—are high.

HOUSING: As everywhere else, obtaining unfurnished accommodation in this area is not easy, but the Company is prepared to help surmount this obstacle by giving assistance to suitable applicants. While no definite assurances can be given, of course, intending candidates are urged *not* to allow the housing problem to stand in the way of their initial application.

Designers (structural and mechanical), aerodynamicists and stress analysts interested in these vacancies are invited to write to :—

The Chief Designer,
THE DE HAVILLAND AIRCRAFT COMPANY LIMITED,
HATFIELD, HERTS.

C. C. WAKEFIELD & CO. LTD • GROSVENOR STREET • LONDON • W.1

THE VIKING IN OPERATION . . .

results, differences in rate of climb of 200-400 ft/min between particular aircraft have been found, and a decrease in airscrew efficiency due to blade-cropping was observed and corrected.

This thorough study of Viking performance is but one typical example of the efforts B.E.A.'s project and development team, led by Mr. R. C. Morgan, chief project and development engineer. The work of these experts, in close co-operation with the manufacturers wherever necessary, has been reflected in all aspects of the development of the type in service.

Operating Experience.—During 1946 and 1947 the airline was building up its pilot strength and training new pilots to operate the Viking aircraft. B.E.A.'s training flight was responsible for the licensing of the pilots, and their training, on the type, to B.E.A. standards, which were in fact higher than those required for the M.C.A. licences. In addition to this, and to other specialized training (e.g., in the use of new navigational aids, and in two-crew operation), the training flight has performed experimental flying to test both aircraft performance and proposed operating procedures, in co-operation with the Corporation's project and development engineers.

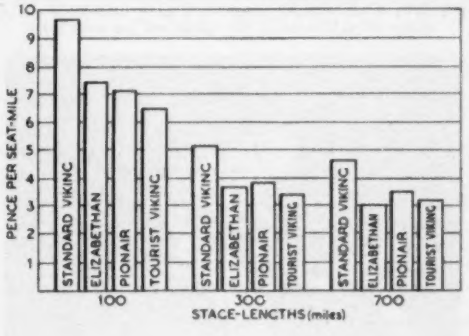
One important change in operational procedure was the limitation of cruising power used during normal flight. High powers, while giving an increased speed and a better ability to make up lost time, had caused a high rate of unscheduled engine removals. After a number of trials, it was decided that a scheduled cruising power of 770 b.h.p. (resulting in a cruising speed of 196 m.p.h.) would give high overhaul periods with a low failure-rate; flexibility and punctuality of operations were to be ensured by a variation in permitted cruising power from 690 up to a maximum of 850 b.h.p.

Possibly the most significant operational change has been the recent introduction of the "variable booking payload" method of flight-planning, in which the use of the previous fixed fuel reserves (arbitrary allowances for holding time plus diversion mileage) is replaced by that of a realistic analysis of the fuel requirement. A range of values for this requirement is obtained, from which any total can be selected together with its mathematical probability of sufficiency. In effect, the method has adapted the "variable fuel" techniques of long-haul route planning to short-haul work, and it has resulted in payload increases, with considerable economic advantage to the operators as a consequence. Effective in Viking operation, the system is expected to be of even greater value with turboprop and turbojet aircraft.

The Admiral Conversion.—Undoubtedly the most important change from the operators' point of view since the introduction of the 1B has been the adaptation of the Viking for tourist-class operation, enabling up to 38 passengers to be carried, with an increase in maximum payload from 5,500 lb to 7,200 lb. This makes possible, and profitable, a further extension of the Viking's operating life, with continued advantages accruing from the extremely large amount of development work performed on the earlier models. Thirty aircraft are to be modified in this manner; eight have been completed to date, and the remainder are expected to be ready by April of next year.

The 38-seat layout is achieved by installing two double *Pionair*-class seats in each row in place of the three single seats normally fitted. By mounting the new seats on frames which are attached by standard Viking floor-fittings, tourist and first-class seating schemes are inter-changeable. To carry the increased loads, the floor supporting structure is strengthened by strutting the floor beams to the cargo-hold floors.

Fig. 5. Comparative operating costs for B.E.A.'s four main types. The effect on total costs per seat-mile of varying stage distance is shown.



The existing galley is replaced by any of several alternative installations, according to the catering standard required for the particular route and number of seats used. The radio installation is re-designed to include Ultra UA. 17 communications equipment, I.L.S. SR. 14A/15A and STR. 12c V.H.F. sets, together with remote control of part of the equipment, for two-crew operation (on those routes on which no radio officer is carried). The crew cupboard in the cockpit is replaced by a fixed fourth crew-member seat, which enables a maximum of 43 persons (38 passengers, four operating crew, and steward) to be carried.

With this conversion, the payload would normally have been restricted by the previous maximum landing weight of 32,500 lb. To permit maximum payload on short sectors, an increase in the weight of some 750 lb was needed. To discover whether this increase was permissible, a thorough examination of undercarriage defects from January, 1950, to August, 1951, was made, and the climb performance of the average fleet aircraft was checked by calculation and flight test against the "category A" airworthiness requirements in the landing configuration. Both these investigations indicated that an increase of landing weight to 33,250 lb would in no way be critical. In addition, structural strength analysis by Vickers showed satisfactory reserve factors for members affected by the weight increase. A.R.B. approval of the increased weight was consequently sought, and was obtained.

Economic Results.—From its first scheduled flight with B.E.A. in September, 1946, to the introduction this year of the tourist-class conversion, the Viking's record of service and continual development is impressive. The adoption of a then untried aircraft made an extremely large amount of development work necessary in the early days, with consequent economic penalty, but through its years of service the type has become known to be a reliable and economic machine. Its recent benefit to B.E.A. is well shown in the Corporation's 1951-52 annual report (from which Figs. 5 and 6 are taken); the effective fleet of 42 Vikings produced over 34 million capacity ton-miles, achieved an overall load factor of 67·7, and earned an estimated traffic revenue of nearly £7 million during the year. As the earlier diagrams (Figs. 1 and 2) show, the future economic prospects with the *Admiral* machines are even better still; maintenance is now simple, and the high-density seating will yield even higher revenue. B.E.A. are anticipating at least three more years' service with the type on British trunk and European routes, but it will certainly be much later than that before the ubiquitous Viking finally disappears from the world's airways. The story of the Viking in operation has by no means ended.

K.T.O.

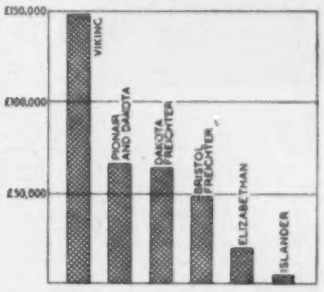


Fig. 6. Revenue earned per aircraft during the year ending March 31st, 1952, for each aircraft type. (On Elizabethan, 116 hours introductory service only.)

B.E.A. VIKING HOURS OF SERVICE

(Up to the morning of Wednesday, October 22nd)

	hr		hr
G-AJVI, Viking (Flagship) ...	8,954	G-AJBT, Sir Thomas Troubridge	8,555
G-AHPL, Lord Anson	7,397	G-AJBU, Lord Bridport ...	8,204
G-AHPM, Lord Rodney ...	8,462	G-AJBV, Sir Henry Morgan ...	8,168
G-AHPO, Lord Dundonald ...	8,581	G-AJBW, Sir William Cornwallis	7,915
G-AHPP, Sir Charles Saunders	8,030	G-AJBX, Sir Edward Hughes ...	7,750
G-AHPR, Prince Rupert ...	8,508	G-AJBY, Lord Torrington ...	7,495
G-AHPS, Sir Daveson Sturdee	8,646	G-AJCA, Sir John Leake ...	6,592
G-AIVB, Robert Blake	8,773	G-AJCD, Lord Barham ...	6,857
G-AIVC, Lord Collingwood ...	8,694	G-AJCE, Lord Exmouth ...	7,837
G-AIVD, Lord Duncan ...	9,054	G-AJDI, Lord Keith	6,893
G-AIVF, Sir James Somerville...	9,133	G-AJDJ, Lord Beatty	6,648
G-AIVG, Sir George Rooke ...	8,734	G-AJDK, Richard Kempenfelt...	6,739
G-AIVH, Lord Howe	9,049	G-AJDL, Lord St. Vincent ...	6,319
G-AIVJ, Lord Jellicoe	8,861	G-AJJN, Sir Charles Napier ...	6,622
G-AIVK, Lord Keyes	8,949	G-AKBG, Sir Thomas Hardy ...	6,693
G-AIVL, Lord Hawke	7,768	G-AKBH, Lord Hood	6,134
G-AIVM, George Monck ...	5,416	G-AMGG, Sir Robert Calder ...	5,890
G-AIVN, Edward Boscawen ...	8,461	G-AMGH, Sir John Duckworth	5,824
G-AIVO, Edward Vernon ...	8,759	G-AMGI, Sir Henry Harwood...	5,427
G-AJBM, Charles Watson ...	8,453	G-AMGJ, Sir John Warren ...	5,793
G-AJBN, Lord Nelson	8,570	G-AMNJ, Lord Fisher	3,393
G-AJBO, John Bonbow	8,704	G-AMNR, Lord Charles Beresford	3,963
G-AJBP, Sir Edward Spragge ...	8,444	G-AMNS, Sir Dudley Pound ...	3,709
G-AJBR, Sir Bertram Ramsay...	8,397	G-AMNX, Sir Philip Broke ...	3,843
G-AJBS, Sir Cloudesley Shovell	8,398		

(Left) TRODIE is seen aboard the U.S.S. "Midway." (Right) the landing of a Fury (naval Sabre) is checked.

Introducing TRODIE

North American Touch-down Rate-of-descent Indicator

DATA provided by the photographic equipment used to determine the rate of descent of an aircraft are not normally available for several days after the event; but, according to the North American company, their new measuring equipment, known as TRODIE (touch-down rate of descent indicator) "flashes this information immediately, at far less cost."

The new instrument was used with conspicuous success in the recent carrier-suitability tests of the FJ-2 Fury and three other U.S. Navy jet fighters aboard the U.S.S. *Midway*, and is now regarded as standard equipment. Portable and easy to handle, it is claimed not only to measure the rate of descent an aircraft structure can withstand, but to help in evaluating the landing characteristics of aircraft controlled automatically or manually; to help instructors teach student pilots the technique of landing; and to aid in determining landing conditions suitable for various aircraft.

The working principle depends on the fact that TRODIE sends out two parallel flat beams of light from two horizontal slits spaced one foot apart vertically. A mirror system on the approaching aircraft cuts the top beam, reflecting the light back to a photo-electric cell, which initiates the charging of a condenser. The descending aircraft then cuts the second and lower beam, reflects it and stops the charging of the condenser.

The electrical charge stored during the interval between the beams is quickly translated from voltage to rate of descent in feet per second.

PERCIVAL JET HELICOPTERS

THE Percival Company is one of several firms working on jet helicopters, and is understood to be aiming first to produce a lifting unit rather than a complete aircraft. In effect, this will be a "motor plus rotor." It is considered that, once the lifting unit is fully proved, various types of container can be produced to fit underneath for the carriage of passengers, freight, or both. The power plant will be in the form of a specially designed gas-producing turbine, fitted in or near the fuselage and delivering high-pressure gas, which is used to drive the rotor blades. The gas is piped out along the blades to the tips, where it is ejected at very high speed. Advantages claimed are lightness and fuel economy.

Work on the special power plants and blades is reported to be well ahead. The rotors will be tested in an underground pit instead of the above-ground cage hitherto generally employed by British manufacturers.

THE VAUTOUR

REPRODUCED on this page is a drawing of France's S.O.4050 Vautour ground-attack aircraft, which recently made its first flight—of 15 minutes' duration—at Mélun-Villaroche. The pilot was M. Guignard.

Designed by M. Parot during 1951, and intended for sonic speeds, this is the newest prototype built for the French Air Ministry. The crew of two are seated in tandem and the two S.N.E.C.M.A. Atar turbojets are slung from the wing, well outboard. Dive brakes are hinged to the fuselage sides. Special consideration was given at the design stage to quantity production and new constructional techniques are said to have been introduced to this end.

The undercarriage is of unorthodox type, designed by S.N.C.A.S.O. and made by Hispano-Suiza.

The Vautour is the second French military prototype to have been designed for sonic speed, the first having been the Dassault Mystère 4 single-seat intercepter, which first flew on September 28th this year.

LIGHT JET

THE SIPA 200 jet-propelled light two-seater, shown n semi-mock-up form at the Paris Show of 1951, is shortly to be flown to Brétigny for comparative trials against a P-47 Thunderbolt. Preliminary tests are said to have shown a cruising speed of about 250 m.p.h. and a landing speed of 56 m.p.h. A 65ft barrier can be cleared about 650 yd from the beginning of the take-off run.

MORE MARTIN CANBERRAS

A SECOND order for a "substantial number" of B-57 night-intruder bombers (English Electric Canberra licence) has been announced by the Glenn L. Martin Company. The initial production order for B-57s was placed in the spring of 1951, and the first production machine is due to leave the assembly line next year. A crew of two—pilot and radio operator/navigator/bomber-aimer—will man the B-57.

It will be judged from the illustration below that the S.O. Vautour—referred to in the adjacent column—is of fairly conventional layout, though all surfaces are of thin section and are swept back.

✻TWO NAMES – ONE ENGINE

Keystone of the aerial defence of the North Atlantic Treaty Organisation, the Armstrong Siddeley Sapphire is now in quantity production in Britain and the United States of America.

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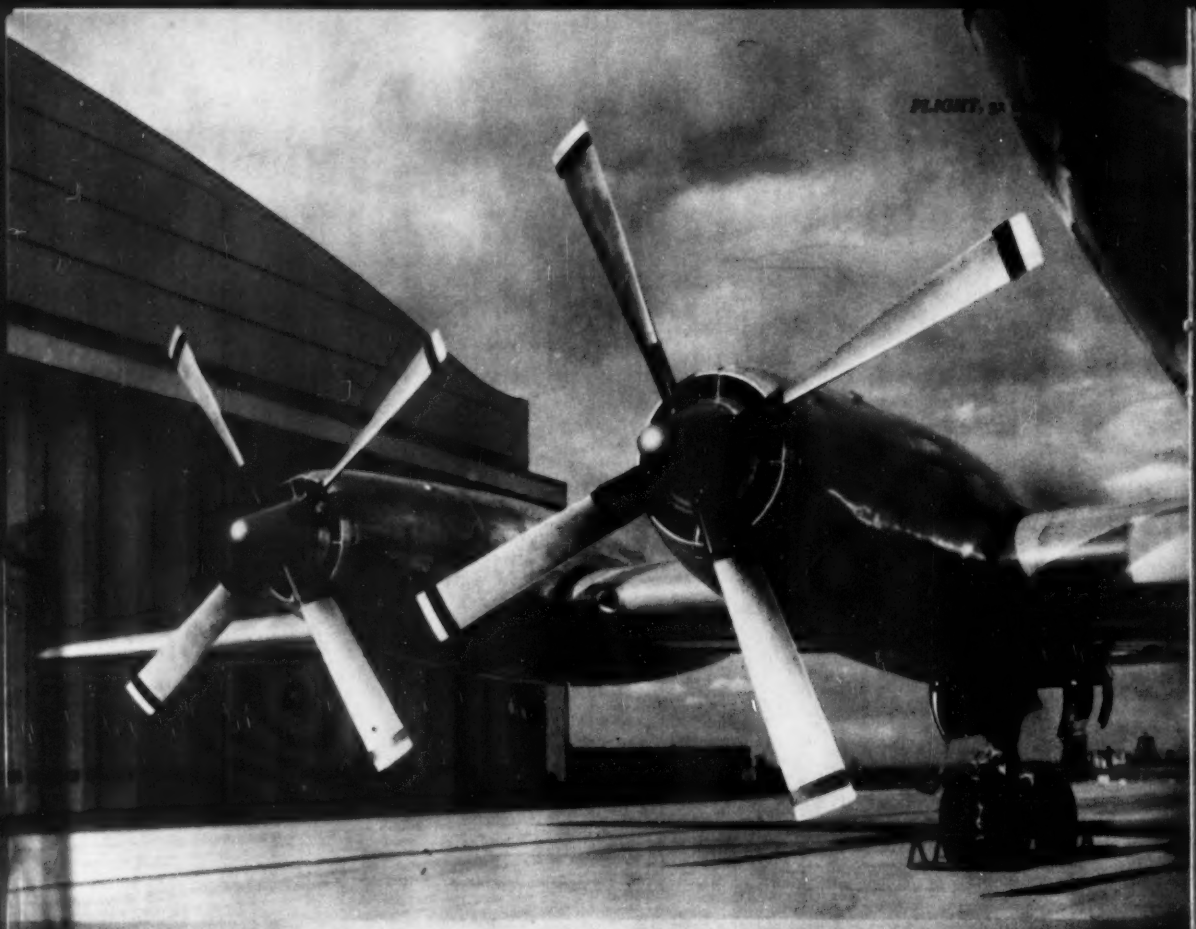


DE HAVILLAND

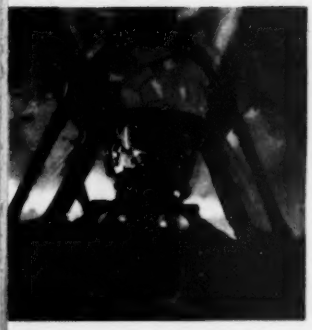
hollow-steel-blade constant-speed feathering and reversing propellers have been chosen for the fleet of 25 "Bristol" Britannia airliners (four "Bristol" Proteus gas turbines) ordered by the British Overseas Airways Corporation.

DE HAVILLAND PROPELLERS

D H
PROPELLERS

Over the top

THE work of F/L. J. de M. Severne, of the Central Flying School, the picture on the left is unusual in that the photographic aircraft was flying ahead of the formation and the pilot—F/L. J. D. Price—was keeping station by looking backwards. The aircraft are all Gloster Meteor 7 trainers. Leading was F/L. C. R. Gordon; Nos. 2, 3 and 4 were, respectively, Master Pilot D. Fisher, F/L. L. A. Titmus, D.F.C., and F/L. D. D. James. Below are three new Russell Adams impressions secured from the back seat of a Meteor 7 in a loop. In the large view the Meteor is on the top of the loop, at a speed of 220 m.p.h.; of the smaller views, the upper was secured while the pilot, Brian Smith, was beginning his pull-out, and the lower depicts the final stage of the loop—at a speed of about 390 m.p.h.

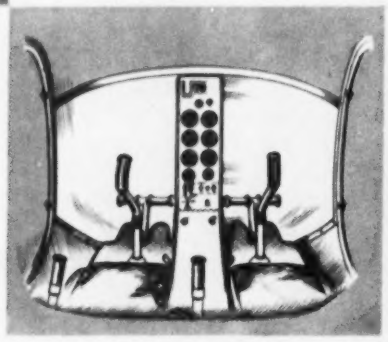


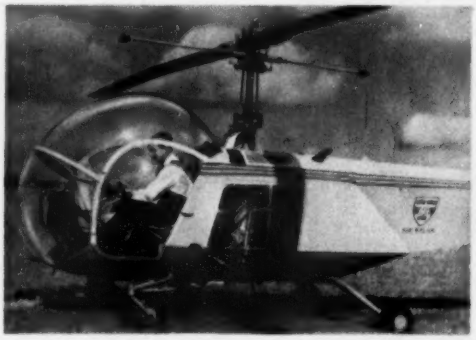
A final dual check with B.E.A.'s Captain John Theilmann in the starboard seat.

CONVERSION TO ROT

EXPERIENCES WHILE LEARNING TO FLY A BE

by THE EDITOR





(Left) The simple cockpit layout of the Bell 47 might mislead one as to the ease of flying a helicopter. Dual controls are the stick and rudder pedals; for the left hand there is the collective pitch lever with twist-grip throttle. Heel-operated electric-starter levers are seen inboard of each stick. (Right) Releasing the stick friction adjustment in preparation for first solo. The collective-pitch lever is seen on its lower stop.

ANY "fixed-wing" pilot who imagines that he can read up the handling notes and then step into a helicopter and fly it, is in for a rude awakening—and he would be well advised to take a qualified whirling-wing pilot with him if he intends to make the attempt. Flying a helicopter is not just a matter of converting to another aircraft. In forward flight the two controls which it has in common with a fixed-wing machine admittedly work in a similar manner, but the same cannot be said of hovering flight, and, therefore, of taking off and landing. Moreover, the sensitive use of engine power and the maintenance of correct rotor and engine speeds is a particularly exacting business for the beginner, especially when it is closely associated with the co-ordination of foot and two additional hand controls.

The only safe approach to the helicopter, for a fixed-wing pilot, is to regard it as a completely new kind of flying machine. He will, however, have the advantage of airmanship and flying experience which should lead to better judgment of approaches and quicker appreciation of circuit requirements, the effects of wind, and so on.

Those readers who have studied helicopters or who fly them will appreciate these points, and also agree that before discussing a course of flying instruction in such machines it is desirable to sort out the controls and their functions for the benefit of those to whom the works of the helicopter are comparatively strange. Before more is written I must stress that this article is concerned with getting to know a light helicopter and learning to fly it safely enough for a first solo. I have a great deal more to learn, and hope soon to have the opportunity to do so.

First of all there are certain terms and characteristics which I found unfamiliar. For example, auto-rotation quite correctly suggested something to do with rotors which fan round without engine power to drive them. Additionally, it also suggested something rather drastic connected with emergency action. Until the course of instruction began I was not sure what it meant in practice. After an hour or two on the Bell 47 I discovered that to glide in a helicopter it is necessary to go into auto-rotation and that this simply entails lowering the collective-pitch lever to its bottom stop and cutting the engine to idling power, the automatic clutch having disengaged. With height in hand there is no difficulty about going in and out of auto-rotation just as one wishes. Moreover, a glide or auto-rotation landing is not so very

Climbing away on the first circuit: note the high position of the collective-pitch lever (pilot's left hand).

Checking descent and forward speed before hovering momentarily, then landing. It took a lot of practice to keep this end of the circuit smooth and progressive.

ATING WINGS

LL HELICOPTER

For take-off a pilot is taught to lift the helicopter vertically to about 10ft, to pause there, and then start the forward climb.

"Flight" photographs

Little did he know . . . "Flight's" photographer records in striking manner a proud moment for the author—his first solo hover some ten feet above the ground.

difficult to make, and is one of the more intriguing bits of flying in a helicopter.

Another thing I had failed to appreciate was the importance of wind speed and direction. For example, a helicopter taking off when heading into a stiff breeze derives just as much help from it as would a light aircraft. Expressed another way, the effect of translational lift is very apparent to the pilot of a helicopter—particularly a light one like the Bell, which has very little power in hand when hovering at maximum all-up weight.

To return to terms, over-pitching was a new one on me, for it has no connection with the caulking of seams, the cricket field or even the well-known game referred to from time to time in the magistrates' courts. It results when the pilot, over-anxious to climb, keeps his collective-pitch lever too far up and so causes the engine and rotors to labour. The symptoms are surprisingly similar to those experienced when, for example, a Tiger Moth is climbed at full throttle at the stall, or when a car is kept in top gear for too long when climbing a steep hill. The revs drop and the engine and vehicle pound and feel as if they were straining against too great a weight.

The term "ground cushion" is easy enough to understand and it is not peculiar to helicopters. However, the exact effect from the control point of view is difficult to detect. I have not been able, for example, to feel the helicopter sink into the cushion or ease out of it, although the disadvantages of trying to hold the machine still at an absolute altitude of a foot or so, within the cushion, are obvious enough.

To return to the subject of the controls, the helicopter has stick and rudder pedals of conventional aircraft appearance with, in addition, another lever or stick for the left hand

Those mainly involved are (left to right) the pupil (the author), Capt. John Thailmann of the B.E.A. Helicopter Unit, the instructor, and Mr. W. S. Nelson, who sees that the aircraft are kept serviceable.

CONVERSION TO ROTATING WINGS...

which carries a twist-grip fine-adjustment throttle of motor-cycle type. Instruments may include A.S.I., altimeter and compass, together with the normal engine dials and switches. Differences are the dials and levers; the absence of a throttle lever (and, of course, airscrew controls) and of blind-flying instruments—on most helicopters; and the addition of a rotor r.p.m. indicator, either as a separate instrument or, as in the case of the Bell, a second needle on the engine-speed dial.

As to the use of these primary controls, while the operating manual gives a fair idea of what the levers do in expert hands, it does not tell one how to fly any more than the rules of snooker enable a new player to pot the colours. Even so, the purpose and operation of these controls must be mentioned here, and attention drawn to the simple cockpit diagram on page 562.

The most familiar-looking control is the stick, sometimes known in the helicopter as the cyclic-pitch lever or, on occasions, as the azimuth control. It is linked to the rotor blades in such a way that forward movement, by causing maximum blade-incidence at one point on the rotation cycle and minimum at a point 180 deg away, makes the rotor assembly tilt forwards or a sideways movement causes it to tilt sideways, and so on. The effect of this is first to tilt the aircraft in a similar manner and immediately afterwards to cause it to move in the direction of inclination. If a helicopter is hovering, the stick is central. When the pilot moves the stick forward, the aircraft noses down and then moves forward. If he moves it sideways, the helicopter banks and moves sideways.

Another conventional-looking pair of controls are the rudder pedals and, in fact, these operate exactly as one would expect. However, a degree of directional stability on a helicopter is only to be found under one condition, namely, when in forward cruising flight, and all the rest of the time heading must be maintained by counteracting the varying rotor-torque with the aid of the tail rotor. This in turn is achieved in response to rudder movements. The rudder pedals control the pitch of the tail rotor, and thus its thrust, but because it is geared directly to the main rotor shaft the tail rotor depends upon main rotor pitch and engine speed for its speed of rotation. In the event of engine failure the tail rotor is one thing that does not need to be worried about, for it will operate so long as the main blades fan round.

Finally there is the collective-pitch lever, which, as the name implies, controls the pitch of all the main rotor blades together. An upward movement of the lever increases pitch, and in the correct sense causes the helicopter to move upwards—always supposing there is sufficient engine power to lift the load. Conversely, a downward movement causes the helicopter to lose height.

These three controls seem to be straightforward enough, but the complications have yet to be mentioned. To start with, the collective-pitch lever has two separate connections with engine power (or throttle) : the first is through the direct movement of the lever. With the aid of a cam mechanism synchronized with the main rotor pitch control linkage, engine power is progressively increased with pitch. If a change of power is desired without alteration of collective pitch, a second fine-adjustment throttle is employed which takes the form of a twist-grip mounted on the collective-pitch lever. This works in the opposite sense to the twist-grip on a British motor cycle.

When the pitch lever is on its down stop—the normal position on the ground—the engine can be run up to full r.p.m. for power and magneto checks with the aid of the twist-grip throttle. When the time comes for take-off, however, the throttle opening is mainly achieved by raising the collective-pitch lever, the twist-grip being given the last fraction of a turn to obtain full power, lift or r.p.m.

We may now consider the operation of the rudder pedals again. So long, for example, as engine power and rotor r.p.m. remain roughly constant the use of rudder may only be called for to compensate for change of forward speed or when direction is to be altered. But, as has been mentioned, collective and cyclic pitch and engine power do not normally remain steady for long, and so the pilot must be co-ordinating his rudder-pedal movements all the time.

In practice the most difficult thing for the beginner is usually the maintenance of steady rotor speeds and the achievement of smooth change-overs from climb to level flight or level to descent. This seems to entail well co-ordinated fine-throttle adjustment, smooth, positive use of the collective-pitch lever, and good maintenance of altitude and control of forward speed with the stick. Once I had learned not to be downright ham-handed, I concentrated on degree of control movement. However, had I appreciated a little earlier the importance of the sequence of actions, the amount of control movement might not have seemed important.

Feel and Stability

Perhaps it will be appropriate to digress here in order to comment on the "feel" of helicopter controls—the Bell is fairly representative—by comparison with those of fixed-wing aircraft of similar weight and power (data figures for the Bell are tabulated on page 566). In my opinion, at this stage of flying the stick has practically no feel of any sort, and except in forward flight there seems to be a brief lag before response to movements. The aircraft is also unstable in the normally accepted sense, and one cannot relax one's hold on the stick for a second.

According to the makers, there is an "additional degree of stability" as compared with other contemporary single-rotor helicopters as a result of the incorporation of a stabilizer bar—a Bell feature. Discussion of individual rotor and control systems has been carefully avoided, but we may mention here that the Bell has a two-blade rotor—as the photographs indicate—and, set at right-angles and just below the blades, the stabilizer bar. Both have a see-saw type of attachment. The inertia of the weights on the stabilizer bar is made (through a mixing-lever arrangement) to feather the blades in such a way as to tend to return the helicopter to a level attitude if it has been tilted. As a result of its attachment, the stabilizer bar tends to follow the mast and the following time can be regulated by means of two adjustable dampers attached to the bar, and thus the degree of stability can be varied.

There seems to be a good deal of friction in the cyclic-pitch control system, and this means that the stick is fairly heavy to use. Unlike the controls of some other helicopters, however, there is no appreciable shake. At the base of the control column there is a ball joint, and the column itself has a sleeve attached to the cover of the ball. By means of a knurled screw-ring at the top of the sleeve, the column can be locked in any position by nipping the cover down on to the ball.

The rudder pedals are very light and effective in use at all flying r.p.m. and, according to conditions, almost maximum travel may quite often be required. When pirouetting left, against the main rotor torque, a good deal of rudder is required and an appreciable amount of engine power is absorbed.

Finally, the collective-pitch lever is irreversible and, once set in level flight, may be left alone. It is smooth and light

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Vignettes of
CANADA — AIR LAND

The prototype of a mechanical gem sleuth, newly developed in Canada, for the detection of diamonds and the prevention of theft, was rushed recently from Winnipeg by airliner to London and thence to Tanganyika. The working model . . . literally delivered to the diamond mines before its final field tests were completed, accounted for a sizeable order which is now being filled by the Canadian company.
This incident, one of many, is typical of how Canada, as one of the world's largest export traders, capitalizes on the use of aircraft.

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CONVERSION TO ROTATING WINGS...

to raise and lower, but the twist-grip it carries is very sensitive and inclined (on this particular aircraft) to be stiff. The full throttle-travel must be covered with what feels like about 120 deg of twist movement (when the lever is down).

The interconnection between collective-pitch power control and the sensitive twist-grip power control is cunningly contrived, and in general the variation of power produced automatically when the pitch lever is operated is very nearly what is required to maintain r.p.m. within the close limits laid down. The fine adjustment is fine indeed, and the accent should be on grip rather than twist. My first attempts to reduce power slightly when preparing to let down resulted in a partial power cut with rapid loss of r.p.m. and a terrifying lurch sideways until I managed to take off enough anti-torque rudder.

These difficulties were accentuated because I was unconsciously using (as I did, incidentally, on several other occasions) fixed-wing sequences, namely, first throttling back to glide and holding the nose level until speed dropped to correct the figure, and finally, adjusting rate of descent and forward speed.

On the Bell the first action is to start to lower the collective-pitch lever, and this not only begins the descent but reduces the power. Next, the forward speed is reduced and held correct with the stick, and finally the fine adjustments are made to power, rotor r.p.m., and rate of descent and to speed. In practice, of course, these actions are not all tackled separately, but more or less together with the order just definable.

The significance of forward speed on the approach to land is quite different in the case of a helicopter, because there is no question of stalling. The rate of descent is not particularly related to forward speed, but is, of course, under the control of the collective-pitch lever. If the stick is moved forward to increase speed the approach is lengthened. There are, however, correct forward speeds according to weight for powered and auto-rotative descents, and to arrive stationary at about 10ft over the landing spot—and all normal helicopter landings should be spot landings—without varying speed or pumping the collective-pitch lever calls for nice judgment. It is this, in fact, which one practices and learns after the individual effects of controls, before flying solo. The hold-off and touch-down as such are looked after during hovering practice rather than as a part of circuit instruction.

Talking of these various practical points has, in fact, been rather a case of putting the cockpit on top of the rotor. But it was done to give the reader a better appreciation of the problems facing any pupil, and more particularly of what was going on during the flights which are now to be mentioned.

Before getting airborne in the Bell I was shown the ground checks for the tail rotor, landing-gear, cowlings, and so on, and the cockpit controls and dials were explained. In the small glass-house of a nose it gets very hot in the sunshine, and the concentration adds a lot more heat. So on some days we flew without doors and we always removed our jackets.

Getting Started

With fuel on and mixture rich, the Franklin flat-six engine of 178 b.h.p. output was primed by giving it four or five full turns of the throttle twist-grip, then, with an "all-clear for rotors," the electric starter was heeled in. After a few moments the engine blurped into action like a dirt-track bike, and promptly stopped again. Next time it started in the same unexpected manner, but we caught it at idling speed of about 1,500 r.p.m. and the automatic clutch started to turn the rotors at once.

Oil pressure was checked at over 30 lb and warming-up continued at about 1,700 r.p.m. By this time both rotor and engine r.p.m. needles were synchronized, indicating that there was no clutch slip. (Rotor speeds of 200 to 230 r.p.m. are avoided for continuous running for stabilizer resonance reasons.) Magnetoes were checked at 2,700 r.p.m., and 3,000 r.p.m. was obtained momentarily so that the stick response could be checked, in full-fine collective pitch. The power was then cut straight back to zero to check smooth and immediate disengagement of the clutch.

At last we were ready to get airborne for a demonstration circuit and experience of other manœuvres. With nose into wind, rudder pre-set with left foot forward, and stick about central, the pitch lever was raised gently (the twist-grip throttle already being partly open) and rotor r.p.m. increased up to about 2,900. The machine then became very light and it was possible to detect what minor control adjustments were going to be needed to unstick cleanly. Another inch up-movement on the collective pitch gave 3,000 r.p.m. and we rose gently to about 10ft and sat there. Then the stick went forward, the machine bowed farewell to its parking circle, and we moved ahead and gently upwards.

As soon as a helicopter starts to move forward (or for that matter when hovering, if it changes from a down-wind to an up-wind heading) less power is required to maintain altitude. According to the makers' data, this reduction in power to hold altitude with increase in speed continues until about 50 m.p.h. At that point the drag of the rotor blades is enough to offset the increased lift resulting from the induced flow of air through the rotors.

We climbed at about 40 m.p.h. (30-50 m.p.h. is the usual climbing speed range according to weight and wind strength) keeping speed steady with the stick and climbing at maximum rate while maintaining r.p.m. at 3,000. The permissible ranges of r.p.m. for engine and rotor, as indicated by green and red arcs on the combined instrument, are respectively 2,800 to 3,000, and 285 to 350. The machine was purposely steered over gaps between buildings and farms so as to have clear ground below in the event of an engine cut during the climb.

At 700ft we increased forward speed and then levelled out at around 70 m.p.h. As mentioned earlier, the helicopter reacts to its stick and rudder controls in forward flight in a similar way to a fixed-wing aircraft. If the pilot wants to increase forward speed he first increases power and then, to prevent any over-revving of the rotor, he may need to increase rotor pitch. At the same time altitude is kept steady by co-ordinating with these earlier movements the forward movement of the stick.

I must confess to feeling very exposed with nothing around or below me but Perspex and space, and a small doughnut tyre projecting below on my right. The tight lap-strap was comforting. The circuit was completed, the approach being steeper and rate of descent more rapid than I had expected. Like a true sprog, I was even reminded of coming down in a lift. On a second circuit we did a run-on landing at about 15 m.p.h. Then it was my turn.

Hot Work

First I took the stick alone and tried to keep still in the air at about 20ft. I worked myself into a state of lather and muscle-tension in about three minutes, and seldom held the machine within 20ft in any direction of the given point. After a breather, I took the pitch lever alone and made rather a better job of holding height steady. Finally I took over all the controls while hovering over a spot, and tried to keep hovering. The course I followed rather resembled that of the lower point of an agitated pendulum. My limbs were positively vibrating with tension and the harder I worked the hotter I became and the more erratic were the results.

Fortunately this phase did not last long, and by the end of my first 25-minute flight I had relaxed a little, halved my control over-correction and had started to attempt ups and downs—lift off and up to 6ft or so and at once let down onto the same spot on the ground again.

On the second flight I attempted a few circuits, and it was then that I started to learn about over-pitching and the difficulty of making smooth changes from climb to level, and level to descent, as described earlier. Climbing speed was easy to hold steady while I watched it, but as soon as I checked something else it wandered. I also began to develop an organ-stop right eye which never left the rev counter, for every change of control or power I made seemed to result in over-revving or falling revs—the effect of allowing rotor r.p.m. to fall below the red line at 285 on the dial was, to me, too awful to contemplate.

By the end of lesson No. 2, or 55 minutes' instruction, I knew roughly what was required, but was quite unable to do anything except fly round the circuit at a fairly steady level, and my confidence in myself as pilot and in the helicopter could not have been lower.

Such improvement as there had been in my attempts to hover were, to me, quite inexplicable, for I was not conscious of doing anything differently from the very first time—it was just that results were sometimes better.

After a break of a day or two the third lesson started, and at first my circuits and hovering were appreciably better but approaches were unsteady. I mostly overshot through not losing all forward speed when flaring out. Use of twist-grip was still clumsy. I also put up a major black equivalent to freezing with the stick of a Tiger well back and the machine on the top of a large bounce—I partially cut the twist-grip throttle when beginning to hover at the end of an approach. This was, perhaps, explained to some extent by the fact that I had ridden a motor-bike that day and instinctively dropped my wrist to get, as I thought, more power. In any case, fixed-wing pilots are not used to landing with full power on.

On my fourth lesson I tried a few run-on landings and practised some more hovering, and on the fifth I quite suddenly seemed to know more and to feel more confident. Hovering was still a little erratic and circuits rough, but I felt that I knew why and that even then, given time, I could put the machine down safely. Control movements had definitely started to have the effects I expected. (The dual time was now 2 hr 20 min.)

After this I started early-morning lessons and did better. I learned to handle the twist-grip delicately and hovered quite well. Run-on landings were practised, and by the end of the seventh lesson, with total instructional time 3 hr 25 min, Capt. Theilmann said that he would be willing to trust me to fly solo. However, we discovered that official permission was still awaited for this drastic step, and I thought twice about it myself, because there

CONVERSION TO ROTATING WINGS...

was an increase in insurance premium for solo flying of some £20 per hour. To myself, I also admitted a certain remaining lack of confidence.

During the next hour I did some auto-rotative practice, including landings, and was shown jump take-offs, and steep turns. Jump starts, incidentally, entail a momentary over-revving of the main rotor on the ground in order to use its inertia to lift a small overload or perhaps to take a normally loaded machine out of a high-altitude field.

Sideways—backwards—sideways—forwards patterns at a height of about 6ft around the marked helicopter enclosure at Gatwick were another practice. I still found pirouettes difficult to keep steady and even, but learned to juggle the controls to stay airborne when turning against torque, down-wind and at full load. Under these circumstances there are moments when, with full throttle, power and lift show signs of being inadequate, rotor r.p.m. try slowly to fall, and one is on the verge of over-pitching.

Just before solo permission came through, I did a short check flight with Capt. "Jock" Cameron and I felt hadn't frightened him too badly. That day I felt I had really buttoned up the descent business and I was able to do him an auto-rotative landing at the right place and finally put him back on the refuelling spot on the tarmac. Moreover, I remembered not to pull the stick back to touch down on the auto-rotative (power off) landing. This is an instinctive reaction most difficult to overcome. In fact, the stick must be held forward on touching down and the pitch lever moved right down.

After a total of 5 hr 50 min dual, feeling much more capable and quite confident, I was sent off to do three circuits and bumps, permission having been given for me to show off for the camera—pictures herewith—and land back on the spot.

In conclusion, I must add a note of appreciation of the hard and very patient work of my instructor, Capt. Theilmann, and in addition acknowledge my indebtedness to Mr. Peter Masefield, chief executive of B.E.A., for making the course of instruction possible, and to W/C. Reggie Brie, official-in-charge of the B.E.A. Helicopter Unit, for his co-operation and valuable advice.

MAKERS' DATA FOR THE BELL 47
178 b.h.p. Franklin Flat-six Engine

Length (main rotor fore and aft)	41ft 2½in
Height	9ft 2in
Rotor diameter	35ft 1½in
Width over torsion bar	8ft 4in
Disc loading	2.3 lb/sq ft
Power loading	12 lb/h.p.
Weight empty	1,380 lb
Fuel and oil	188.6 lb
Loaded weight	2,078.6 lb
Max. cruising speed at s.l.	92 m.p.h.
Max. rate of climb at s.l.	1,025 ft/min
Range (75 per cent power)	214 miles or 2.3 hr
Endurance (60 per cent power)	2.8 hr

CROP-SPRAYING EXPERIMENTS

Results of Some Official Investigations: The War Against the Tsetse Fly

A BRIEF yet informative account of work being carried out by the Colonial Insecticide Research Unit, Porton, in regard to aircraft crop-spraying techniques is given in the annual report of the Colonial Insecticides, Fungicides, and Herbicides Committee. (It is understood that the report will shortly be publicly obtainable.)

Reference is made to the completion during 1951 of the design and development of an installation for the production of a spray with a mass median drop-size of 200-400 microns diameter. The constant-flow automatic control arrangement incorporated in earlier aircraft spray-installations has been modified for use with this apparatus. Trials carried out with this equipment fitted to an Avro XIX showed that the average mass median diameter was within the limits laid down, and that a constant rate of flow was obtained at both the minimum and maximum output rates.

The 90-deg. bend type of emission pipe fitted with the automatic constant-flow-rate apparatus was also modified in order to obtain a measure of component standardization between the two systems.

The report also mentions that a modified type of the boom and nozzle equipment used on an Anson has been designed and manufactured as a result of experience gained by the Colonial Insecticide Research team in East Africa. It is further noted that an exhaust smoke-producing apparatus has been fitted to an Avro XIX; some preliminary trials to determine consumption and other figures have taken place and further trials to determine the drop spectrum of the smoke produced are in hand.

The committee expresses thanks for the constant, valuable help given to them by the Chief Superintendent and staff at the Chemical Defence Experimental Establishment at Porton.

In a later section of the report, the work of the Colonial Insecticide Research Unit in East Africa is described, with particular reference to aerial spraying against tsetse fly. The aircraft used in these studies are owned and operated by Airwork, Ltd.

One experiment conducted last year consisted of seven aircraft applications each of ¼ lb. D.D.T. per acre (in oil solution) to about 15 square miles of bush infested with three species of tsetse flies. Two Ansons fitted with boom and nozzles were used. The final results, announced a year after the last application, showed reductions of 99.1 per cent, 95.6 per cent, and 99.9 per cent in respect of each species. Later inquiries gave no evidence that the infestation was returning to its previous level.

Another experiment concerned the second spraying, with B.H.C., of a previously treated block of infested bush during the long rains. This block of nine square miles had been treated in 1949 with eight fortnightly applications of B.H.C. smoke produced by injecting 10 per cent solution of B.H.C. in kerosine and furnace oil into the exhausts of aircraft. This reduced the species in question by about 93 per cent. Since then the flies had increased, and it was considered useful to try a second series of applications during the wet season whilst the bush was in full leaf. This was done with only one aircraft, fitted with boom and nozzles, and using a 20 per cent solution of B.H.C. in oil at a lower emission rate and greater swathe-width. The heavy rains (40 inches in two months) greatly interfered with operations and reduction of flies was only about 90 per cent.

A third test was the spraying of thicketed ravine. With the assistance of the Tanganyika Tsetse Department a thicketed ravine near Arusha was selected for spraying. Fly rounds were carried out under the direction of the Provincial Tsetse Officer, and spraying started in July. During the third application, in bad weather, the aircraft crashed and was burned out. Fortunately there were no casualties, but the experiment had to be abandoned. Useful experience was, however, gained in spraying such areas with the aid of a pre-arranged plan based on aerial photographs, and without the use of ground markers.

At this point in the report there is an interesting reference to an experiment conducted by Mr. Alkin of Airwork, Ltd. Using a borrowed aerial camera, he has constructed photographic mosaics of Atta Island; of the Pallidipes ravine area; of Ukara Island, near Mwanza (it is suggested a joint experiment with the Director, East African Medical Survey may eventually be carried out here); and of the Musoma area, proposed as a site for a large-scale tsetse-eradication experiment.

Meteorology is one of the subjects also discussed, and it is reported that experiments carried out have so far shown a correlation between the degree of atmospheric turbulence and the distribution and deposition of the finer droplets. Screening effects of vegetation and the deposition of small droplets on test insects are being studied. The results of the investigations should form an adequate basis upon which control measures with such droplets may be designed.

Climatological readings in an open situation have now been made for a year, and it is hoped that a detailed account of the variations in conditions of turbulence for various times of day and for different seasons will soon be available. This should be of considerable value in planning Aerosol applications in East Africa Some investigations have also been made into turbulence in acacia woodland.

Air spraying experiments were also carried out at Dar-es-Salaam and satisfactory results were achieved, but there has been difficulty in deciding how much of the apparent reduction was due to this method. Catches in stations outside the township but adjoining the sprayed areas did not remain as low as would be expected from 100 per cent larval kill, but the adult insects caught may have emerged from unsprayed areas or from the creeks during a ten-day period when spraying had ceased following an accident to the pilot of the aircraft.

It is intended that these catches (which were organized and carried out by the East Africa Malaria Unit, with whom this experiment was jointly undertaken) should continue through the coming rains, when more information on the efficiency of the air-spraying should become available.

PROBING and DROGUEING

British Equipment Standardized for American Aircraft and Used in Korea

THREE basic flight-refuelling procedures have so far been publicly announced; and two of these have been developed in the United Kingdom by Flight Refuelling, Ltd., of Tarrant Rushton, Dorset. Discounting the rudimentary hose-dangling practised in the 1920s and later, the first practical method of fuelling aircraft in the air was the "looped-hose" method, which Sir Alan Cobham, K.B.E., A.F.C.—now chairman and managing director of Flight Refuelling, Ltd.—developed in the 1930s.

The procedure consists of the firing of a line from the tanker after the manner of the projection of harpoons or rescue lines from ships; the light cable falls across a similar cable streamed by the receiver aircraft, to be caught by a grapnel. The linked cables are then wound into the receiver aircraft, towing the fuelling hose after them. This method, it may be recalled, was once used by Imperial Airways' flying-boats and by the "round-the-world" Boeing B-50 in 1949.

A second Flight Refuelling development is the "probe-and-drogue" system, with which we are here chiefly concerned.

The third arrangement is the "flying boom" of the Boeing Airplane Company. Here, a rigid pipe is hinged to the rear end of the tanker and the receiving aircraft approaches to within "striking distance" of the pipe's outlet. The pipe is then "flown" by an operator within the tanker who controls a pair of "butterfly" control surfaces mounted on the pipe's free end. The pipe boom is also extensible, and—controlled in range and direction—the boom is directed into the receiving nozzle. It will be appreciated that the onus for making contact is placed upon the boom operator in the tanker.

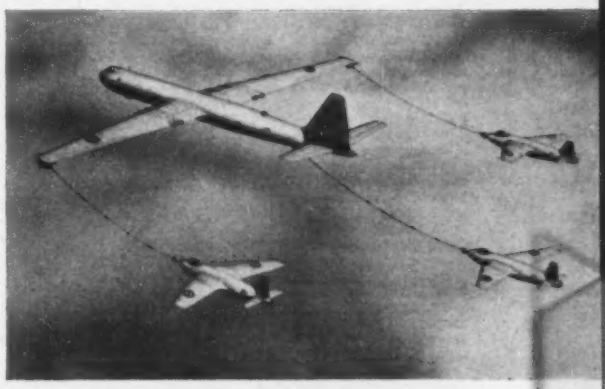
With the probe-and-drogue system, this responsibility rests with the pilot of the receiving aircraft. The tanker aircraft is equipped with a hose drum which is electrically driven *via* a fluid coupling at a constant torque. This torque is so controlled as to apply a tension to the hose slightly less than the drogue drag. The tanker hose operator then streams the hose whenever a receiver aircraft approaches—the proximity of the receiver being indicated by a radar responder-beacon.

The receiver pilot comes up astern of the tanker and flies his probe into the drogue at an overtaking speed of about 5 m.p.h. This procedure is quite straightforward, for the drogue offers a large target and holds the hose quite steady in flight. The push of the probe then assists the tanker's hose motor to wind back some of the hose; when five feet have been pushed in refuelling begins automatically.

About 75 to 100ft of hose is normally trailed—sometimes marked, inch-tape fashion, at suitable intervals—which permits relative movement of the receiver anywhere within a sphere of some 40ft diameter. Passage of fuel is indicated by a green light on the tanker; if the receiver aircraft drops astern so that the last five feet of hose begins to unwind, an amber light replaces the green, indicating to the receiver pilot that fuel is no longer flowing. To break contact the receiver pilot merely throttles back, the probe pulling from the drogue at about 600 to 800 lb load, the fuel valves closing automatically.

The fuel valve in the nose of the probe can be actuated by an ancillary power system or, for fighter use, it can be opened automatically upon engagement with the drogue. Fuel transfer rates of over 400 gal/min have already been achieved with a single hose; fuelling speeds above 250 knots are already practicable; and both fuelling rates and speeds are likely to show substantial improvement in the near future.

It will be appreciated that any aircraft fitted for pressure fuelling is readily adaptable to flight refuelling, the only additional equipment required being a blanked-off fuel pipe near the ground fuelling point, and provision for a probe. Even aircraft not pressure fuelled can be fitted with probes, and fighters of the U.S.A.F. have long been fitted with probe-equipped drop tanks. In this connection we may refer to a remarkable exploit, the story of which has only lately cleared for publication, though it took place in Korea over a year ago. The aircraft concerned was a Lockheed F-80A Shooting Star, flown by Maj. (now Lt.-Col.) Harry W. Dorris. Taking off from a Japanese base at 5.10 a.m. on September 28th, 1951, the fighter carried a full underwing load of two 500-lb bombs, five-inch rockets, guns and ammunition, and cameras. During the day, the F-80 attacked several targets in North Korea far beyond the range of any normal single-engined aircraft; films were brought back showing a unique series of highly successful strikes from low altitude—where fuel consumption is highest.



Although these aircraft are hypothetical, the artist is not merely illustrating a future possibility; three fighters have already been fuelled in this manner, though where and when cannot yet be stated.

Eight in-flight fuelling rendezvous were made with a KB-29 tanker using British flight refuelling equipment. In fact, 16 "probings" were made, each drop tank being filled separately. The Shooting Star eventually landed at 7.25 p.m. at its Japanese base; it is believed that this airborne time of 14 hr 25 min is an all-time turbojet record. No radio contact was attempted between fighter and tanker, to avoid interception.

It has been reported—particularly in the S. American Press—that the U.S.A.F. has been using Flight Refuelling equipment in Korea for upwards of a year; another report states that probe and drogue equipment only has been used in this theatre. It can also be said that all new American fighter designs embody provision for a probe; but of British decisions nothing can be at present published.

Various factors arise from the standardization of such a system as this. Any fighter pilot, trained to fly in formation, can "probe" without difficulty, even when he is tired from a sortie of long duration. But there are mechanical and aerodynamic considerations. For one thing, the probe must be in such a position that the drogue does not blanket the ram air to the jet intakes; the probe must be visible to the receiver pilot—not so easy, with heavily-swept-wing probes—and the drogue must not blanket the receiver pilot's view of the tanker. But, it appears, a probe can be fitted on any type of aircraft.

The latest convert to probing is the U.S. Navy. They have studied in-flight refuelling techniques with care, and also with a sense of urgency, for their carriers have had to go right in to the Korean coast far too often, in order to employ fighter cover on their numerous low-altitude piston-engined strikes. It is now a U.S. Navy requirement that all fighters should have a probe attachment, and the Grumman F9F Panther and Cougar, and the McDonnell F2H Banshee are already so fitted.

The standard U.S. Navy tanker is the North American AJ-1 Savage which, at 55,000, lb is the heaviest carrier-based aircraft type. The Allison J-33 turbojet booster engine is first removed from the rear fuselage, and a hose unit and belly tanks are then fitted in the rear bomb-bay. (A Savage/Panther probe-and-drogue photograph has been published showing an experimental hose unit, emerging from the Savage's jet-pipe orifice.) The soon-to-come Convair R3Y turboprop transport boat—developed from the XP5Y—will also be a tanker, a hose unit being fitted in each wing tip.

This fuelling of fighters is but one step from the in-flight fuelling of bombers. It would appear logical for the U.S. Navy to adapt their excellent Douglas A3D twin-jet bomber to take a probe, so giving it greater bomb-load, for a given range, than the U.S.A.F. B-66, which is an A3D variant for land-based work. In fact, there does not appear to be any immediate limit to the possibilities of the probe-and-drogue system, either in speed, altitude, or flow rate. And it is a British system throughout.

CORRESPONDENCE

The Editor of "Flight" does not hold himself responsible for the views expressed by correspondents in these columns; the names and addresses of the writers, not necessarily for publication, must in all cases accompany letters.

Records Risks?

YOUR readers will have learned with pride of the magnificent achievement of the crew and their mount, the Canberra, on its record-breaking flight to Nairobi.

There are, however, one or two disquieting observations in the account published in your issue of October 17th, and I quote for easy reference: "W/C. Connolly lined up on the runway visually, set his directional gyro, closed the direct-vision panel, and took off blind."

I ask: what would he have done had he been in difficulties just after becoming airborne?

"Towards the end of the run the Air Chief Marshal was keenly map-reading; and W/C. Connolly was anxiously searching for Nairobi. The Canberra was buffeting furiously at full speed, and burning fuel at a great rate—with fuel for only a few minutes' flying remaining, Nairobi appeared."

Another ten minutes and Nairobi not ahead, a "belly landing" on what type of terrain?

Finally: "Four days were spent in Nairobi, during which time none of the Canberra trio was permitted very much sleep."

They then flew back to U.K. After their exacting flight out, coupled with four days' parties and lack of sleep, one would not expect them to be in the best of condition physically for another arduous flight.

It seems to me that very grave and unnecessary risks were taken for this record-breaking flight. It was a peace-time flight without any operational "must" attached to it, with a very brilliant and valuable senior member of the Royal Air Force aboard.

London, S.W.15. SAFETY FAST.

[The account was written in colloquial terms and some of the remarks should not have been taken too literally. Most records entail some risk—usually well considered in advance and deemed justifiable. C-in-C. Bomber Command personally ordered the flight and was surely the man to judge the factors involved.—ED.]

The Famous D.H.4

I WAS most interested in the article on the D.H.4 in your issue of October 17th and glad to note that this is the first of a series. May I, however, for the sake of history, be allowed to make a few corrections and perhaps to add one or two relevant items?

Individual Machines (page 507).—It may be of interest to record that F.2694 (G-EAHG), F.2699 (G-EAHF), F.2702 (G-EAJC) and F.2704 (G-EAJD) were all used by Aircraft Transport and Travel, Ltd. F.5764, mentioned as becoming a D.H.4A of No. 24 Squadron and illustrated on page 508, later became G-EAWH and was operated by Handley Page Transport, Ltd.

"Instone Air Lines" (p. 509) should read "Instone Air Line," and "Air Transport and Travel, Ltd." should be "Aircraft Transport and Travel, Ltd."—an oft-repeated error.

"Queensland and Northern Territory Air Service" should read "Queensland and Northern Territory Aerial Services, Ltd.," and I think "Qantas" was not used in this form at that date but was written as "Q.A.N.T.A.S."

I believe the Q.A.N.T.A.S. fleet details are inaccurate. Mr. W. Hudson Fysh, then managing director and now chairman o Qantas Empire Airways, Ltd., in the course of the first British Commonwealth and Empire Lecture in 1945, said that "the Charleville-Cloncurry service was started with two A.W. FK.8 aircraft and a D.H.4." I have in my collection a Q.A.N.T.A.S. photograph dated 1923 which shows a three-seat open D.H.4, two A.W. FK.8s and an Avro 504. Mr. Hudson Fysh also said that Q.A.N.T.A.S. got the D.H.9C in 1923.

The photograph on p. 510 said to be of an Instone D.H.4A, is in fact that of the Aircraft Transport and Travel, Ltd., D.H.16 G-EAPM named *Agincourt*.

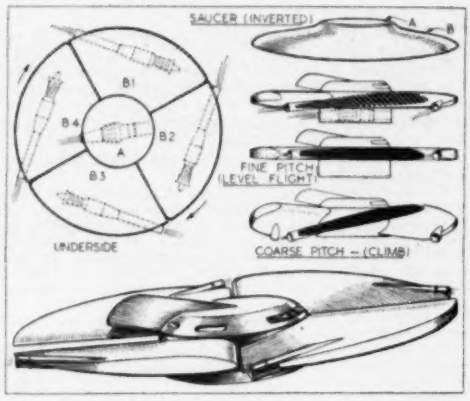
London, W.14. JOHN STROUD.

Feasible Flying Saucer?

I MUST first explain that although I have read *Flight* regularly since I was eight years old, I have never been directly concerned with flying in any form, being by profession a farmer. It is, therefore, with great humility that I offer you my reasons for thinking that "flying saucers" are aerodynamically feasible.

I must ask you to refer to the accompanying piece of paper covered with odd objects. First you will see what appears to be a saucer, inverted. It is. Now let us persuade it to fly.

It must obviously function by some sort of revolving motion, so let us say that the part of the saucer that normally rests on the table (A) will be stationary, and the rim or outer portion (B) will rotate round A. Presupposing power available for this motion, we must now impart lift. Referring to the plan view of the saucer, divide it into four sections, B1, B2, B3, and B4, and construct each section in the form of a wing, unusually thick, and with greater chord at its tip than its root. Now these four "wings" will be connected to each other at their roots, and will revolve together on bearings round the centre A. Now imagine these wings to be the blades of a four-bladed airscrew set in such fine pitch as to have no thrust but gearable into very coarse pitch. Therefore the leading edge of each wing will be to a greater or lesser extent above the trailing edge of the preceding wing, according to pitch. Then let a jet engine be embedded in each wing, with intake under the leading edge, and tail-pipe on the tip of the trailing edge.



The five-turbojet flying saucer outlined by Mr. G. R. Lockington Bates.

Now the centre will contain in its upper portion the cabin (saucer inverted for our purpose) and its lower will house a fifth jet engine with a flexible tail-pipe. The centre thus would form the shape of a squat round tower, with the lifting surfaces revolving round the upper part, and the lower projecting slightly below.

Let us now, having constructed a small flying model powered by, say, four Turboméca Palas and a Ghost, go for a flight. We will be sitting in a spacious cabin with windows all round. The only flying controls will be pitch, and the flexible jet-pipe on the Ghost underneath us. The outer engine controls and the pitch control will have to work on some sort of trip system. The fuel supply might be centrifugal. We are then seated. The machine rests on the base of its tower. We start the wing jets, with the revolving surfaces set in extreme fine pitch. As soon as they are revolving sufficiently, we slowly "let in the clutch" by coarsening pitch. As the revolving wings bite the air, the thing will lift vertically off the deck, maintaining a level position. The Ghost is now started in the base of the tower, giving us a forward motion. I am not sure if the tendency of the tower to rotate could be counteracted by deflecting the jet or if this would be used for changing direction. Perhaps a fin and rudder might be utilized. The more we coarsen pitch, the more rapidly we rise, fairly screwing upwards, at the same time being propelled forwards by the Ghost. Level flight would result when the pitch was fined to the correct amount; downward movement by reversing pitch, stalling, or maybe feathering. I think this contraption would climb incredibly fast, take off like a lift, and land the same way. Also it could support heavy weights and be safe in case of engine failure by just rotating slowly downwards. Would forward speed be assisted by rotation?

In my own mind I have no doubt that it would fly well, but what I know about these things is entirely nil, and if it were possible and practical, I take it that they have already been constructed and account for the "Bright discs, revolving, and climbing away at great speed" which have been reported so frequently from all over the world.

If you think a lot of nonsense like this is worth printing, carry on.

Marandellas, S. Rhodesia. G. R. LOCKINGTON BATES.

Do you know your airfields?

29

Recognise this airfield? It's No. 29 in this series of puzzle photographs. You'll find the answer below on the right. ★

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SUPERSONIC BANGS

Two More Contributions to an Important Controversy

THE two articles on this subject which have appeared recently in our columns (by A. H. Yates on October 3rd and C. H. E. Warren on October 17th) have given rise to further correspondence, and below we print two letters which—apart from the question of their length—merit treatment outside the Correspondence page. It will be seen that one of them is from a senior technician who will almost certainly have been concerned with the design-calculations of an aircraft which, since the S.B.A.C. Show, has been most often quoted as a producer of sound-barrier detonations—the Hawker Hunter.

HAVING read the two explanations put forward by Messrs. Yates and Warren of the "bang" phenomenon associated with supersonic aircraft, I feel inclined, somewhat belatedly, to offer what seems to me to be an explanation most in accord with fact. For this it is necessary to indulge in a little geometry, for which I apologize.

In the past few months there have been many published and unpublished accounts of people hearing this explosive noise spread over a range of anything from two to a hundred miles, from what is presumed to be the centre of the disturbance. Consider the simple analogy of a searchlight beam projected by means of a somewhat inefficient parabolic reflector. The area of intense illumination of a plane cutting the beam will depend upon its distance from the projector and its angle of inclination to the direction of projection. It also follows that the mean intensity will be inversely proportional to the area of illumination. Returning now to the projection of noise by the aircraft travelling into the supersonic regime, we may treat this problem in exactly the same way. The difficulty that faces the scientist in interpreting such accounts is, however, the precise meaning of the word "bang," which can include anything from a pronounced "tap" to a catastrophic explosion.

Before considering this point in more detail, let us consider how the noise is generated. Suppose an impulsive pressure disturbance of infinitesimal magnitude be generated at $(x=o,\ y=o,\ t=o)$ (restricting the problem to the x, y plane). Then at time t the disturbance covers the circle given by: $x^2+y^2=a^2t^2$ where a is the speed of sound. Suppose a second disturbance be generated at $(x=V\delta t,\ y=o,\ t=\delta t)$, then at time t the disturbance covers the circle: $(x-V\delta t)^2+y^2=a^2(t-\delta t)^2$.

The condition for intersection is that the radius r_1 of the first circle, minus the distance between the centres, is smaller than the radius r_2 of the second, i.e.:

$$r_1 - V\delta t < r_1$$

or $$at - V\delta t < a(t-\delta t)$$

or $$V > a$$

These two disturbances can reinforce if the circles intersect and they will do so at the points given by:

$$x_0 = \tfrac{1}{2}V\left\{(V^2-a^2)\,\delta t + 2a^2t\right\}$$

$$y_0 = \pm\sqrt{a^2t^2 - \tfrac{1}{4}V^2\left\{(V^2-a^2)\,\delta t + 2a^2t\right\}^2}$$

If we now consider several circles initiated at $(x=V\delta t_n,\ y=c,\ t=\delta t_n)$ for $n=1,\ 2\ldots m$, then the points of intersection will depend upon δt_n except in the case $v=a$ when $y=o$ and $x=at$, for any value of n.

Suppose now we consider, as produced by an aircraft, an infinity of disturbances generated at each point of the x-axis sequentially in time such that $(x=Vt',\ y=o,\ t=t')$. Then we have shown that when $V<a$ only one circle can pass through any point (x, y) of the plane at a given time, and in the case $V>a$ at most two circles can pass through any one point. In the exceptional case $V=a$ all the circles pass through the point $(x=at,\ y=o)$. This is in itself sufficient indication of the exceptional nature of sonic flight. There is, however, another conclusion to be drawn, and that is that since the reinforcement of the infinitesimal impulses occurs at the same time and place as each new one, then the pressure at these points rises proportionally with time, so that if the atmosphere could sustain it one would suppose infinitely large pressure ultimately or, more particularly, that the forces acting on an aircraft build up with time when travelling at sonic speed. This gives rise to the supposition that sustained sonic flight is impossible. It may be supposed from this that we have proved that, since they are caused by sustained sonic flight and that this in itself is impossible, then the 'bangs' are also impossible. However, one must remember that in building up these large pressures the local velocity of sound is changed so that we are no longer concerned with perfect circles, but with distorted shapes, some of which pass through a small finite region, provided the speed of the aircraft is sufficiently close to the free stream velocity of sound at the time of their generation.

Von Kármán* has already hinted at the result that a steady solution of the equations of fluid flow is impossible at sonic speeds. There is a further indication of this result when one remembers that subsonic forces depend upon $(\sqrt{1-M^2})^{-1}$, and supersonic upon $(\sqrt{M^2-1})^{-1}$, The case $M=1$ is obviously exceptional.

The main criticisms of Warren's ideas are:—

(1) The magnitude of the bang depends upon $(r_0)^{-1}$ so that *retardation* is excluded as a source of such effects.

(2) That supersonic flight can also lead to bangs. Clearly, in the preceding analysis we might expect the noise level to be twice as intense in the supersonic regime as in the subsonic, but this does not imply a "bang."

(3) That aircraft pass steadily through the speed $M=1$ because pilots report a steady rise in the Machmeter readings. I need only refer to the possibility of sudden changes in position error for Mr. Warren to admit that the Machmeter reading is no proof whatsoever of what the aircraft is doing at these speeds.

(4) According to Warren's theory, one could expect the region in which the noise was heard to be roughly circular. The general concensus of accounts seems to indicate that the region is much more extended in the plane of the flight path than perpendicular to it.

Returning to the question of the region in which the effect is heard, there can be no doubt that the variation of pressure, temperature and density with altitude gives rise to curved paths for plane waves or shock fronts. That circumstances can occur when the "bang" cannot reach the ground can be shown quite simply. Furthermore, should temperature or pressure fronts occur in a vertical plane, both reflection and refraction of the noise will happen. Thus, without full meteorological data and a full flight history, it is beyond the scope of anyone to say where, or over what area, the noise should be heard.

Finally a word as to the multiple "bangs." Mr. Yates' suggestion that the aircraft touches sonic speed at several instances during the dive is sufficiently plausible as to need no further comment than that the time intervals and intensities are such as to tie in very well with the flight histories.

Kingston-on-Thames, Surrey. B. A. HUNN,
Senior Mathematician, Hawker Aircraft, Ltd.

**Article by Von Kármán in "Journal of Aeronautical Sciences," July, 1947.*

SURELY Mr. Warren has made very heavy weather of his theory of the origin of supersonic bangs? He seems to have travelled all round the world to get to York. Will you allow me to put forward the following criticisms of his article?

In the first place, he starts off by making an arbitrary discrimination between the "noise" of an aircraft and the "aerodynamic disturbances due to the aircraft . . . propagated in all directions with the speed of sound." But what *is* the noise of an aircraft if it is not an aerodynamic disturbance propagated with the speed of sound? All such aerodynamic disturbances are sounds, even though they may normally lie outside the auditory range of the human ear. One can only suppose that Mr. Warren takes the "noise" of an aircraft to mean only those sounds which it emits when it is stationary—with the engine running, presumably. I feel quite sure that Mr. Yates meant the word to include also the sounds caused by its passage through the air.

In the second place, his rather complicated mathematical analysis, with its imaginary string of barrage balloons popping in and out of existence like a conjuring trick, seems hardly necessary if it is merely to demonstrate that, when an aircraft is approaching the observer at the speed of sound, all the aerodynamic disturbances emitted will reach the observer simultaneously. This is, of course, perfectly true, whether one speaks of "pressure disturbances" or "noises," and Mr. Yates treated it quite rightly as self-evident.

Thirdly, it is not possible to follow his analysis closely, since the more important steps are taken "off-stage," so to speak, and we are only presented with the results. In particular, although the factor τ appears in his final expression, we are given no hint as to what its numerical value may be. In any case, this final expression

SUPERSONIC BANGS . . .

is open to some suspicion. In equation (1) Mr. Warren says that r_0 is the aircraft's acceleration *away* from the observer. Under normal conditions, therefore, when the aeroplane's speed of approach to the observer is increasing, r_0 will be negative, and the expression $\sqrt{\frac{4s}{r_0 t^2}}$ will have no rational value.

It is surprising to find that both Mr. Yates and Mr. Warren have given serious consideration to the possibility that the bangs may be caused by the "accumulation" of noise—even though the latter does, at least, reject the theory. Sounds are not material objects like stamps or coins that one can "accumulate." When a source of sounds is travelling towards the observer, the pitch of the sounds is raised and their frequency increased by the factor $\frac{s}{s-v}$, where s is the speed of sound and v is the speed of the source. An aeroplane approaching at half sonic speed will have the frequency of all its sounds doubled, and therefore raised in pitch by an octave. If its speed is $\frac{1,023}{1,024}$ of the speed of sound, every sound emitted will be raised in pitch by ten octaves, and most of them will be beyond the highest pitch that can be heard by the human ear; even if the sounds could be "accumulated" there would be nothing in the accumulation but a collection of shrill squeaks. When the speed of approach is equal to the speed of sound, the frequency of all sounds emitted becomes infinite; that is to say, no sound is emitted at all, and there is nothing to accumulate. There is merely a wave of pressure travelling immediately ahead of the aeroplane. If we like to assume that this is the same thing as the so-called shock-wave, then it seems that both of Mr. Yates's theories coalesce into one.

Now the bang heard on the ground by the observer is indistinguishable, so far as my own and my friends' experience goes, from that caused by the shock-wave from a minor explosion, such as the firing of a gun. Since the effects are similar, the causes must be similar; the air disturbance which reaches our ears and causes the supersonic bang must be of the same nature as the shock-wave set up in the air by an explosion. So much for what happens on the ground. In the air, when an aeroplane travels at supersonic speed, it gives rise to a shock-wave, whose wave-front lies at an angle to the aeroplane's line of advance known as the "Mach angle." Like all other such waves, the shock wave advances in a direction at right angles to its front—which is the complement of the Mach angle. The wave travels through the air with the same speed as all other such waves, and will reach the observer on the ground in a certain position at a certain instant. This position and this instant are precisely those at which, according to Mr. Warren's theory, the observer may expect to hear a supersonic bang. Mr. Warren is no doubt right when he denies that the shock wave has any connection with the bang, but it is at least a curious coincidence that the bang is always heard, and only heard, at the moment when the shock wave strikes the ear. I feel sure that your readers would be glad if Mr. Warren would enlarge on this point.

Horning, Norfolk. N. YOUNG,
Wing Commander (ret.).

CONFIRMED RECORDS

AMONG a large batch of records recently confirmed by the F.A.I. are the Canberra course records established over the Atlantic and to East Africa; W/C. R. P. Beamont was the pilot on the former flight, and W/C. H. P. Connolly (with Air Chief Marshal Sir Hugh P. Lloyd as a crew-member) on the latter. The metric figures given by the F.A.I. for the Belfast-Gander-Belfast round-trip are equivalent to a speed of 412.2 m.p.h.; the return journey was made at 605.2 m.p.h. To Nairobi, the average speed was 428 m.p.h., the overall time having been 9 hr 55 min from London. Other course records confirmed include those of T. W. Hayhow to Stockholm and back (134.6 m.p.h. out, 102.1 m.p.h. back, 114.2 m.p.h. average), and to London from Madrid at 115 m.p.h.—all these records were, of course, gained by the familiar yellow Aiglet.

The world class records include closed-circuit seaplane records for the U.S.A. (L. Davis, Piper Super Cub, at 105.5 and 108.8 m.p.h., for 500 and 100 km circuits, and Harold E. Mistele, Cessna 170, at 102.2 and 109 m.p.h. over the same distances). Another American record is the distance of 1,362 miles flown by R. C. Faris in a Mooney M-18L (in the "under 500 kg" class), and to America also go the single-seat sailplane "fixed goal and return" distance of 260.5 miles, helicopter distance of 1,217 miles, and women's multi-seat sailplane "fixed goal" distance of 170.3 miles.

INDUSTRIAL BUILDING

AIRCRAFT-INDUSTRY executives concerned with the subject of factory extensions will be interested in a statement made in the Commons on October 1st by Mr. R. A. Butler (Chancellor of the Exchequer) in reply to questions regarding the industrial building programme.

Asked by Mr. Roy Jenkins what steps H.M. Government proposed to take to achieve the bigger factory building programme for 1953, Mr. Butler replied that licences were to be issued for more industrial building, particularly for projects which would assist the balance of payments. The steel allocation for such building was to be raised, but it would still be necessary to adopt modern methods of construction which saved steel. Mr. Jenkins then asked whether this increased building programme was to be at the expense of other forms of building, or if it was to be brought about by devoting a greater total of the national resources to the building industry as a whole.

The Chancellor said that there had to be adjustments in the total building programme to make this possible; regarding the latter part of the question, Mr. Jenkins might be satisfied that the total building programme was within the scope of what Mr. Butler thought the country could afford. Asked if he could say how much this plan would interfere with the country's housing programme, Mr. Butler replied that the Government proposed to go ahead with their housing programme and to achieve results very much more remarkable for the families of Great Britain than those achieved by the late administration.

A GLIDER'S 10,000 LAUNCHES

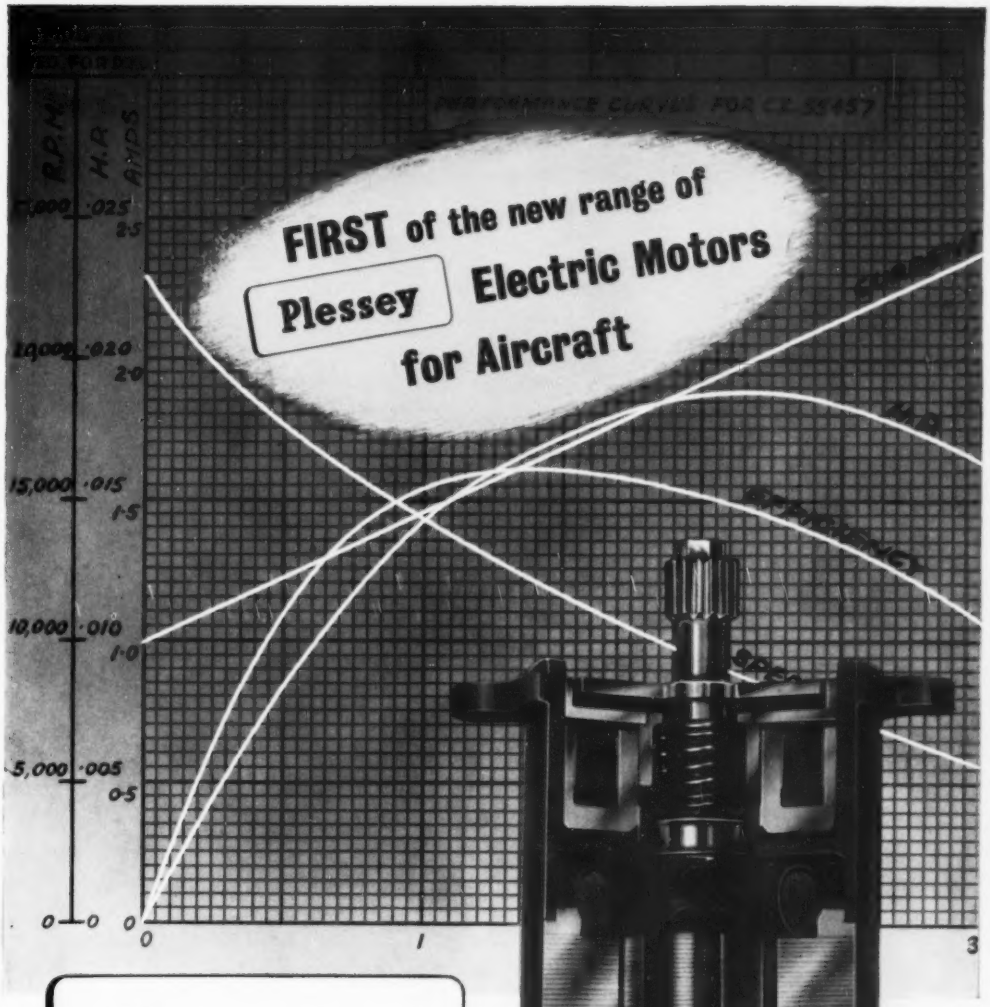
POSSIBLY the first civil-operated glider in this country to complete 10,000 launches is *Daisy*, a Slingsby T-21B two-seater owned by the Surrey and Imperial College Gliding Clubs. She reached the magic figure at Lasham on October 18th, when Ann Douglas and Wally Kahn shared the dual honour of making the flight.

Bought in 1948, *Daisy* was delivered to Redhill, promptly lost her tailskid in the old Sommerfeld tracking and was provided with a tailwheel. Since then she has only once suffered slight damage; this tribute to her handling and constructional qualities is underlined by the fact that some 300 different pupils have made their first, and not always tentative, experiments in landing from her beamy cockpit. Twenty-five different instructors have been in charge of her.

Ann Douglas tell us that *Daisy* knows the circuit at Lasham, her present base, "so well that she finds her way round in spite of the advice of the instructor or the ministration of the pupil."

FORTHCOMING EVENTS

Oct.	31.	R.Ae.S. Graduates' and Students' Section: Informal Reception and Dance.
Nov.	7.	Helicopter Association: "Operational Future of the Helicopter," by P. G. Masefield, M.A.(Eng.), F.R.Ae.S.
Nov.	8.	British Interplanetary Society: "Evolution of Life in the Universe," by Prof. J. D. Bernal, F.R.S.
Nov.	12.	Institute of Transport: Anniversary Luncheon.
Nov.	12.	R.Ae.S.: First R. K. Pierson Memorial Lecture: "Rex Pierson—an Appreciation and the Lessons of his Work," by Sir A. H. Roy Fedden, M.B.E., D.Sc., M.I.Mech.E., F.R.S.A., M.S.A.E., F.R.Ae.S. (Lecture at Weybridge.)
Nov.	14.	R.Ae.S. Graduates' and Students' Section: "Liquid Fuel Rocket Motors"—Three Papers, by B. R. Diplock, B.Sc., Grad.I.Mech.E., Grad.R.Ae.S., D. L. Lofts, Grad.R.Ae.S., and R. A. Grimston, Grad.I.Mech.E., Grad.R.Ae.S.
Nov.	18.	R.Ae.S. Graduates' and Students' Section: "An Introduction to Helicopters," by J. D. Sibley, B.Sc., Grad. R.Ae.S.
Nov.	19.	Royal United Service Institution: "The 'Bismarck' Operation in the Light of German Records," by Cdr. R. F. Jessel, D.S.O., D.F.C., R.N.
Nov.	20.	R.Ae.S. Section Lecture: "Design of a Wind Tunnel Balance," by L. E. Leavy, A.F.R.Ae.S., and C. J. Saunders.
Nov.	21.	Institute of Navigation: "The Vertical Reference in Navigation," by W. A. W. Fox and D. Barnett.
Nov.	25.	Society of Instrument Technology: Symposium on "Control Valves." Papers by A. R. Aikman, B.Sc., H. R. Walton, B.Sc., A.M.I.Mech.E., and B. W. Balls, B.Sc., A.M.I.Chem.E.
Nov.	27.	R.Ae.S.: "Photo-elasticity and Aircraft Research," by Col. H. T. Jessop, T.D., M.Sc., F.Inst.P.
Nov.	29.	S.L.A.E.: "The Bristol Proteus Gas Turbine," by D. Dekkers.
Dec.	2.	R.Ae.S. Graduates' and Students' Section: "Aerodynamics of Wind Tunnel Design," by J. C. Gibbings, Ph.D., B.Sc.(Eng.), Grad.R.Ae.S.
Dec.	3.	Royal United Service Institution: "The Air Battle," by Air Chief Marshal Sir Robert Saundby, K.B.E., C.B., M.C., D.F.C., A.F.C.
Dec.	4.	R.Ae.S. Section Lecture: "Air Traffic Control Today and Tomorrow," by Capt. V. A. M. Hunt, A.F.R.Ae.S.
Dec.	5.	Helicopter Association: "Simulation of Flight Loads by Ground Tests," by M. J. Brennan, B.Sc., and R. Hafner.
Dec.	13.	British Interplanetary Society: "Guidance and Control of Missiles," by J. Humphries, B.Sc.(Eng.), A.M.I.Mech.E., A.F.R.Ae.S.



Plessey

This low-power reversible split series field motor for actuators is the first of the new Plessey standard motors. It is fitted with series brake, and fully tropicalised. Others, soon to be available, will cover a diversity of power applications in aircraft. Where necessary, Plessey will modify a standard design to fulfil any special requirements.

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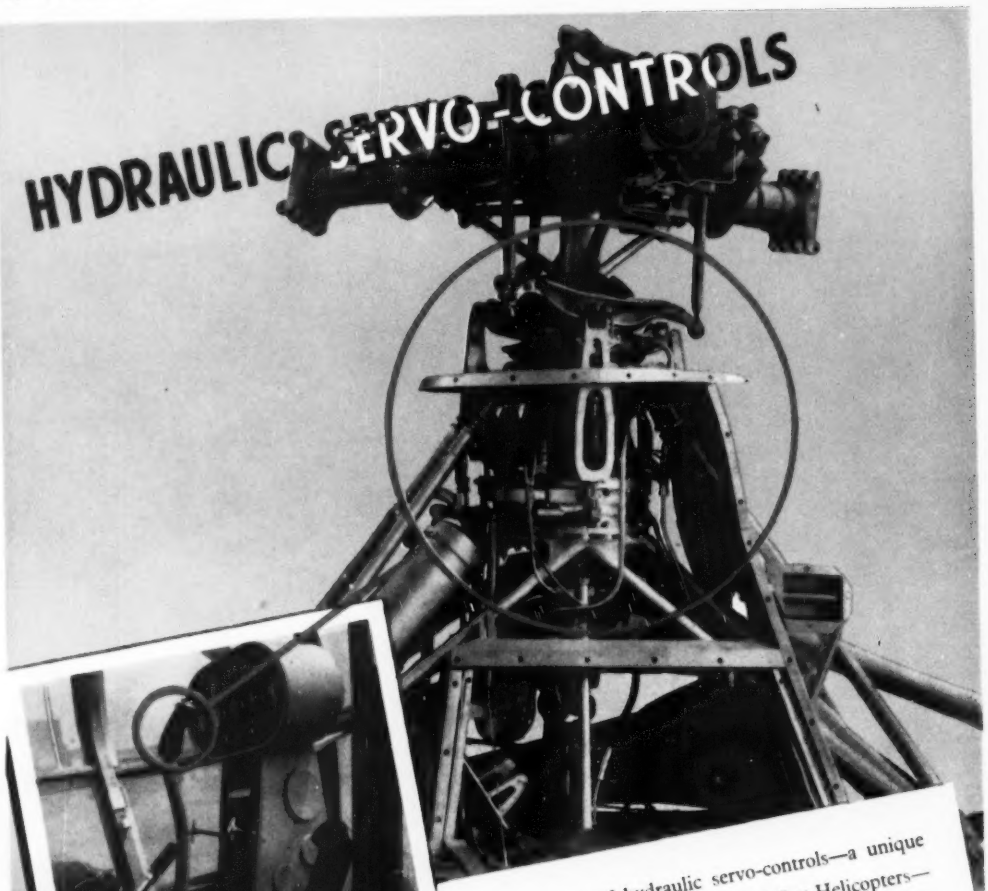


The fitting of hydraulic servo-controls—a unique feature of the Westland S51 and S55 Helicopters—has removed much of the tedium of pilotage. Coupled with the all-metal blade system, they are but typical of the technical advances introduced by Westlands in the S51 and S55 Helicopters which now have well over half a million operational hours to their credit.

If you are interested in the development of the Helicopter, why not join the Helicopter Association of Great Britain, Londonderry House, Park Lane, London W.1, which is represented in its membership by all the principal manufacturers, designers and users of rotary winged aircraft.

WESTLAND S·51 & S·55 HELICOPTERS

WESTLAND AIRCRAFT LIMITED · YEOVIL · ENGLAND

NEW HOP: The Sydney-London "Kangaroo" service, jointly operated by Qantas and B.O.A.C., now includes Frankfurt as a European port-of-call. Pictured there on October 16th, this Qantas Constellation was the first Australian airliner since the war to make a scheduled flight through Germany. Services between Montreal and Dusseldorf were, incidentally, due to be opened by T.C.A. on Wednesday.

CIVIL AVIATION

AIRWORK'S TRANSATLANTIC FREIGHT PLAN

SUBJECT to approval by the Air Transport Advisory Council and by the Minister of Civil Aviation, Airwork, Ltd., intend to open scheduled all-freight services between London and New York and London and Montreal. Initially, services will be operated four times weekly with specially modified Yorks, which Airwork describe as only a stop-gap in the absence of more modern aircraft. Their ultimate plan is to provide two alternative services to New York, one with turboprop freighters taking twelve hours for the westward crossing, the other a high-speed pure-jet service taking about seven hours, and to this end Airwork are investigating the relative merits of all likely British aircraft. This investigation includes the Britannia (with particular reference to the "enlarged all-freight version"), the civil variant of the Valiant, the Comet 3 or 4, and, as an additional possibility, the civil version of the Avro Vulcan bomber.

Airwork believe that the frequency of service will expand rapidly as soon as operators realize the value of a 24hr freight service to America and they have plans for operating as many as three and four services daily. On the basis that a Britannia would carry about 15 tons per trip in each direction, they estimate that a six-hourly frequency would give a total annual capacity of 22,000 tons in each direction. As nearly 10,000 tons of freight were carried between Europe and North America last year, Airwork believe that higher frequency than four times daily can readily be visualized.

Carrying payloads in the region of five tons, the Airwork Yorks will make the Atlantic crossing in short stages (initially, at least)—*via* Shannon or Prestwick, Reykjavik and Gander. If, as Airwork hope, the A.T.A.C. reach a favourable decision within 4-5 weeks, the company should be ready to launch the services by January. Meanwhile, expert advisers are being commissioned to survey the potential freight market. Horses are among the many types of cargo which can be profitably flown across the North Atlantic; K.L.M. have, in fact, flown over 1,000. Other current operators of Atlantic all-freight services are Air France, S.A.S, P.A.W.A. and two leading American freight carriers—Seaboard and Western, and Slick. In tackling the freight market, Airwork are taking full advantage of the new Government policy towards independent companies, and B.O.A.C.'s consequent promise not to operate any new freight services for a period of one year.

POSTAL TRIANGLE: New York Airways have introduced a helicopter mail service linking the three major airports of La Guardia, Idlewild and Newark. This Sikorsky S-55 inaugurated the service on October 15th.

EXTENDING TOURIST TRAVEL

PRECISE details of rates and fares for European tourist services, scheduled for introduction next spring, are now being worked out at Cannes, meeting-place for the second I.A.T.A. Traffic Conference of 1952. The delegates, representing some 50 member-airlines, are also discussing the possible scale of fare-reductions involved in introducing the new grade of air travel on Pacific routes. Under the chairmanship of Mr. Dennis Handover (S.A.S.), the conference began on October 21st and is expected to continue until November 10th. It is, incidentally, the last of the series of twice-yearly traffic conferences; it was agreed at the last I.A.T.A. annual meeting (*Flight*, September 26th) that one annual conference would be sufficient.

Internationally, cut-rate or "tourist" fares began on May 1st—over the North Atlantic route. Fares were reduced by 30 per cent, provided that passengers flew in more densely packed aircraft and were not offered "bait" in the form of meals or souvenirs. The result was gratifying—an increase of some 50 per cent in transatlantic passenger traffic, without any decline in first-class bookings.

It does not follow, however, that all the airlines expect equal results on the shorter European routes. The long-range aircraft is more amenable to "tourist" conversion; many more seats can be installed, and it can thus be profitably operated despite reductions in fares. Such types as the Convair 240, however, have obviously very little cabin-room to spare for extra seating. It has already been agreed that decreases in European fares will be less drastic than those for the North Atlantic—20-25 per cent by day. By night, the reductions will be greater—33-38 per cent; this, however, is explained simply by the common policy of increasing utilization during off-peak hours.

There are, broadly speaking, two schools of thought behind the current Cannes discussions: one points to the success of the Atlantic experiment and argues that extensive fare-reductions will tap new markets as yet undiscovered by the airlines; the other urges a cautious build-up of traffic, with tourist seats forming a comparatively small proportion of the capacity offered to the public. Dr. Berchtold, president of Swissair, is reported to have said on arrival at Cannes that he did not think second-class travel was yet practicable on all European routes. B.E.A. are likely to be among the airlines taking the more optimistic view, particularly as their fleet is reasonably well suited to the demands of tourist operations.

CIVIL AVIATION . . .

BOEING SHOW THEIR HAND

PLANS for producing a competitor to the Comet were announced last Monday by Mr. Wellwood Beall, vice-president (engineering and sales) of the Boeing Airplane Company. According to an agency message, Mr. Beall said that the prototype was well under construction and would be flying in 1954. The first commercial delivery would be made in 1956 and the aircraft would be available in quantity in 1957. His company had allocated $25m (nearly £9m) for the development of this prototype, and the design would be adaptable for duty as a military transport or tanker aircraft. It has been suggested both here and in America that Boeing's "Comet-killer" would be based on the design of the B-47 Stratojet, but Mr. Beall is quoted as saying that it will bear no relation to either the B-47 or the B-52.

The only details of the specification revealed in the report are as follows : capacity for 80-120 passengers; range at least 2,400 miles; speed (whether maximum or cruising is not stated) 600 m.p.h.; ceiling 40,000ft; price, between £892,000 and £1,420,000. The wings will be swept back, but no other design details are given.

First reports credit Mr. Beall with the curious statements that the Comet 3 is "not a very good plane" and that the earlier marks of Comet "were not designed to make money." The Boeing jet airliner, he claimed, would be more economical to operate than the Comet 3. As recently announced by de Havilland, the first Comet 3s will be completed late in 1956 and the type will be available in quantity in 1957. If, as the Boeing company apparently claims, an appreciably better American product will be on the market at the same time, there seems no reason why an American operator should decide to buy British. But not only did Pan American World Airways recently decide to buy three Comet 3s, with an option on seven more, but their president, Mr. J. T. Trippe (who had presumably been provided with up-to-date information on the Boeing project), described the Comet as "the first jet transport built to operate efficiently over the principal routes of the Pan American system."

During last week two senior executives of Trans World Airlines —Mr. Paul Frederickson, director of flight operations, and Mr. Bob Rummel, chief engineer—were among the visitors to Hatfield. They flew in a Comet and discussed with company officials plans for future production and development of the jet airliner. The T.W.A. representatives also visited Filton and Weybridge to inspect the Britannia and Viscount, and flew in both types.

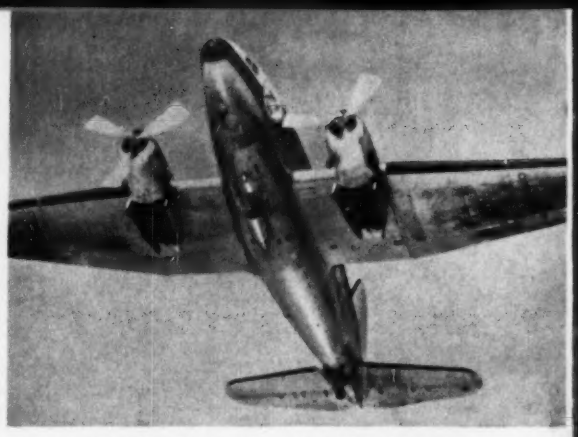
THE CONSUL INQUIRY

A PUBLIC inquiry began in London on October 23rd into the loss of the Morton Air Services Consul which came down in the English Channel, on June 14th, with the loss of six lives. According to the evidence given by the two survivors, the Consul was more than half-way across the Channel on its way to France when there was a recurrence of roughness in the running of the starboard engine. The pilot, Capt. L. Page—who lost his life—announced that he was returning to Croydon, and it was noticed that he was signalling "Mayday" as the aircraft turned.

According to one witness, the port engine was under full power when the aircraft hit the water at 120 m.p.h., the pilot having given no ditching instructions to the seven passengers. It emerged at the inquiry that Capt. Page, a former R.A.F. warrant officer, had resigned from B.E.A. early in 1950 after being downgraded from captain to first officer. B.E.A. reports on his qualities as a pilot were quoted in court, including one which referred to his "unpredictable and erratic behaviour." Early this year he joined Crewsair, Ltd., as a first officer and, it was stated, conducted himself in a "satisfactory and reliable manner" until dismissed owing to failure to report for duty.

COMET MISHAP

THE first major "incident" involving a Comet occurred last Sunday evening at Rome Airport—happily without injury to crew or passengers. The aircraft was a standard Series 1 Comet on "Flight BA115" (scheduled service from London to Johannesburg); it carried a crew of six (headed by Capt. R. E. H. Foote) and 35 passengers. At the time of going to press a B.O.A.C. statement had been issued on Monday as follows : "Evidence at present available shows that a port engine lost power during the take-off, causing the aircraft to swing on becoming partly airborne. With great skill the pilot made an immediate landing on soft ground just beyond the threshold of the runway. Although the wing tanks were punctured, the fact that the Comet runs on paraffin precluded damage by fire. All the passengers and crew walked out of the aircraft." A substitute Comet arrived in Rome on Monday, and all but two of the passengers continued their journey. The de Havilland Company stated on Tuesday evening that according to their information at that stage they had no reason to believe there was any loss of power from any engine, or any failure on the part of the aircraft.



UPLIFT : The take-off performance of this Curtiss C-46 Commando is improved by the fitting of a Turboméca Marbore turbojet unit in a pod beneath the fuselage. Further details of the experiment, which is being carried out by the Flying Tiger Line, appear below. Aerocontacts hold an English licence for similar Turboméca take-off aids, and Blackburns have manufacturing rights for these useful French lightweight turbojets.

TRANSATLANTIC MILESTONE

FLYING from New York to Lisbon on October 23rd, a DC-6B of Pan American World Airways completed the company's 40,000th transatlantic flight since the inception of transatlantic passenger services in June, 1939. During that period aircraft of P.A.W.A. have logged 281m miles and have carried 1,619,122 passengers.

BOOSTING THE COMMANDO

AN American all-freight operator, the Flying Tiger Line, is experimenting with the use of a Turboméca Marbore turbojet as a means of improving the performance of its Curtiss C-46s (as illustrated on this page). Rated at 880 lb s.t., the Marbore and its 82in-long pod weigh 461 lb, a figure which includes the electric starter, anti-drag doors (which shut off the intake in flight), oil and instruments. Fuel is supplied from the main tanks. The entire nacelle, which was designed by Flying Tiger engineering staff, is suspended beneath the C-46 centre section at the c.g. position.

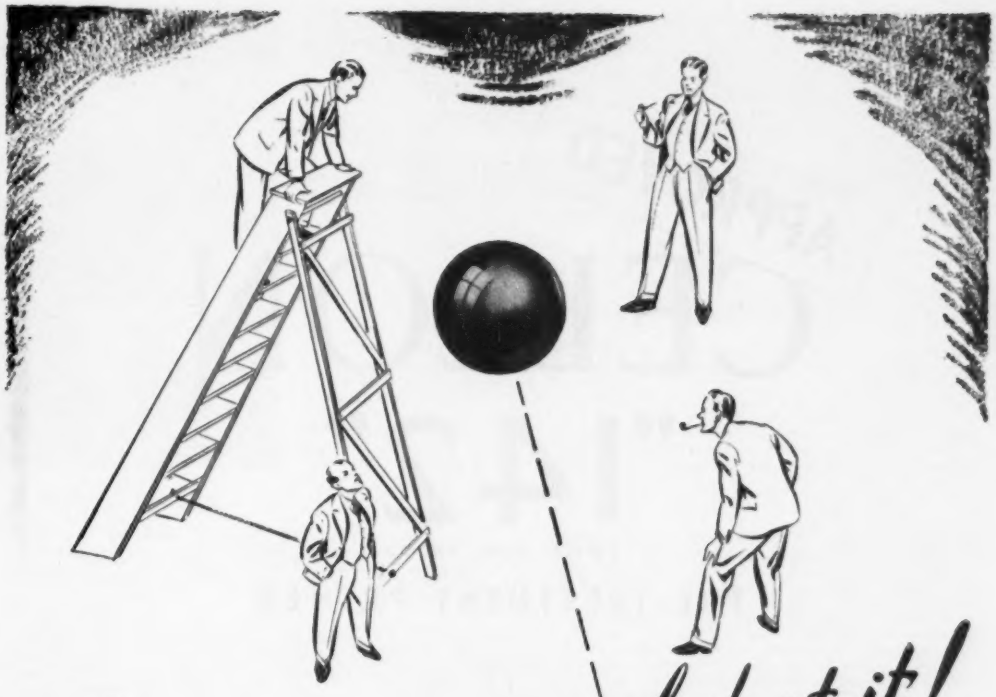
Experiments are being sponsored jointly by the airline and the Continental Engine and Engineering Corporation, which holds the U.S. licence for manufacture of nine types of Turboméca lightweight turbojet. Claimed to be the equivalent of a 10 per cent increase on single-engined C-46 performance at sea-level, the Marbore will be used by the Flying Tiger Line for five-minute periods on and after take-off. In this way the company hope to "protect" the C-46's present a.u.w. of 48,000 lb, and, possibly, obtain an increase after further trials.

CHARTER NOTES

IN the seven days ended October 25th, the charter activities of Britain's major independent airlines, reviewed collectively, show very considerable improvement; and for this full credit must be taken by the York operators. If statistics for individual companies are studied, however, it will be observed that two or three airlines have been burdened over the past month with fast-depreciating aircraft which have never left the ground; the operators concerned are among those who do not rely on trooping work for the bulk of their revenue. In the past week or so four-engined aircraft have once again become easily available on the open charter market; this is due to an easing of the crew shortage and the completion of some aircrafts' annual overhaul.

During the past week the number of *en route* charter trips completed was 105, of which 91 originated in Berlin in connection with the freight and refugee ferries; the total distance flown was about 86,000 miles. Thirty-two passenger flights accounted for 25,000 miles and 73 cargo trips for the remaining 61,000 miles; Berlin flying was about one third of the total in terms of distance and revenue. Altogether, about 1,550 passengers and 410 tons of freight were uplifted, all but 100 passengers and 35 tons of freight in Germany. Total freight ton-miles were about 215,000 and passenger miles about 440,000 (about 40,000 f.t.m.). As stated, Yorks were very busy; in fact they accounted for 52,000 of all the miles flown; Dakotas covered 22,500 miles and Bristol 170s, 11,500 miles. Flying time was approximately 500 hours and estimated revenue reached a new recorded peak of £44,000.

By far the busiest company last week was Skyways of London. Apart from completing more than half of the week's total trooping work they covered nearly half the charter mileage. Their Yorks flew to Bangkok and Colombo, the former city being the terminal of K.L.M.'s Far East freight service which Skyways now operate



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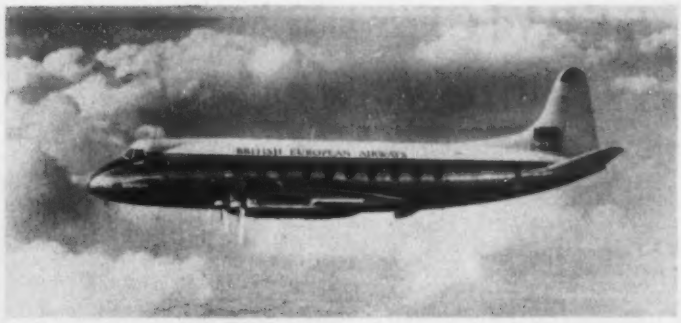


DISCOVERIES: Both prototype and production models of the Discovery (B.E.A. name for the Vickers-Armstrongs Viscount) are now flying in the Corporation's colours. Above is the first air-to-air picture of G-ALWE, flagship of the fleet of 26. Pending introduction of regular services, early next year, the prototype Series 700 Viscount (G-AMAY) is engaged in a series of proving and development flights, totalling 200 hr. Last week it visited Dublin and Shannon, giving Aer Lingus officials a preview of their new inter-city airliner (the company has four on order). On the left, Capt. W. J. Scott, Aer Lingus operations manager, in the co-pilot's seat, is seen with Capt. R. Rymer of B.E.A. Capt. Rymer has the distinction of being the first commercial pilot to have a turboprop endorsement on his licence.

CIVIL AVIATION . . .

under sub-charter once a week in one direction; Colombo was the destination of a party of Moral Re-Armanent officials. A shorter Skyways York flight was from Manchester to Dublin with eight tons of newspapers. The company's Dakota also reappeared on the charter market by flying freight to Nairobi under sub-charter to B.O.A.C.

Eagle Aviation completed stage two of a contract to fly 40 cattle from Karachi to the West coast of Brazil; they flew the first York-load of 20 in a single trip and returned to Karachi to the refill. The other currently active York operator, Air Charter, completed 56 trips from Berlin—28 to Hanover with 1,450 passengers and 28 to Hamburg with 200 tons of freight. The crew shortage which has prevented the Yorks, Tudor and Dakota of this company from entering the open charter market recently has now been overcome.

B.K.S. Aerocharter sent a Dakota from Paris to Kuwait with explosives and then on to Addis Ababa with mining equipment. Scottish Airlines flew 24 passengers to and from Cyprus in a Dakota for the N.A.A.F.I. Silver City Airways, operating Bristol 170s, completed 35 trips from Berlin to Hamburg and Hanover, lifting a minimum of 175 tons of freight. They also flew about 28,000 lb of Normandy cheese across the Channel from Le Touquet to Lympne.

BREVITIES

THE Canadian Air Transport Board last week approved an application by C.P.A. to operate an international scheduled service from Vancouver to Mexico City, Lima, Sao Paulo and Rio de Janeiro.

* * *

For the first time in its operating history, Air France is to maintain full summer frequencies during the winter-schedules period to a number of points in the French Union, South America, the Near East, Turkey, Austria, Germany and Switzerland.

* * *

Thirty-seven Eton schoolboys, members of the college aeronautical society, recently visited London Airport as guests of B.E.A. They inspected the Corporation's new maintenance base and the latest development work on the Airport and were then flown over their school in a B.E.A. Elizabethan.

* * *

The Emperor of Ethiopia paid an official visit to Asmara Airport, Eritrea, on October 17th, in the course of which he inspected one of Aden Airways' DC-3s. Four of the company's officials, including the managing director, Mr. R. de Graaf Hunter, were presented to the Emperor.

* * *

United Air Lines announce that revenues in the first nine months of 1952 were the greatest for any such period in the company's history, and after taxation 22 per cent more than in the first three months of 1951. United's net earnings for the period were $8,263,000 compared with $6,745,500 in the corresponding period last year.

* * *

Work on new terminal buildings at Renfrew Airport will start in January or February, and, it is hoped, will be completed in a year. The cost is expected to be in the region of £150,000. At the centre of the new buildings will be a passenger concourse with customs on one side and administrative and technical offices on the other. A broad stairway from the concourse will lead to a glass walled dining room overlooking the airport. A plan to build a new civil terminal at Turnhouse was approved in principle at a meeting of the Scottish Aerodromes Board in Glasgow on October 13th.

Delivery is reported of 13 of the 18 de Havilland (Australia) Drover three-engined feederliners for which orders have been placed in the Commonwealth. The largest order placed, by Qantas, is for seven Drovers; T.A.A. have ordered six; three will be used by the aerial medical services and two more by the Government's civil aviation department.

* * *

A reference to the visit to Paris by a B.O.A.C. Comet (in connection with the première of *The Sound Barrier*) is made in an official French report on recent activity at Paris airports. Making the first visit by this type to Orly, the Comet fitted comfortably into the traffic pattern and its approach and landing were effected without any difficulty.

* * *

Having studied the possibility of operating Irish internal services additional to those between Dublin and Shannon, Aer Lingus concludes that helicopters, in their present stage of development, promise to be capable of the economical and flexible operation which such services would demand. The amount of capital required to provide the airports and facilities needed by fixed-wing aircraft would be prohibitive in a country which at present has so few modern airports.

* * *

The appointment is announced by the Ministry of Civil Aviation of Mr. C. G. Phillips, O.B.E., B.Sc., as Director of Navigational Services (Telecommunication) from November 1st. Mr. Phillips, who entered the civil aviation branch of the Air Ministry in 1937 and served with the R.A.F. as a Wing Commander in Signals Intelligence during the war was, until recently, Divisional Telecommunications Officer in the M.C.A.'s Scottish division. In his new appointment he succeeds Mr. R. W. J. Sullivan, B.Sc.

* * *

Captain Peter Gibbes, Flight Superintendent of Australian National Airways, recently returned to his country full of enthusiasm for British aircraft, having watched the S.B.A.C. show and flown in the Britannia, Viscount and Comet during his stay in England. He described the Britannia as being eminently suited to Australian airline operations, and forecast that the smoothness and freedom from vibration of all three types would be a revelation to the travelling public in Australia.

SERVICE AVIATION

Royal Air Force and Naval Aviation News

BOUND FOR ASTON DOWN, this Canberra B.2, flown by F/L. Monty Feldman, of No. 2 Ferry Unit, joined company with a Meteor 7, with Gloster test pilot Jim Cooksey at the controls. Two of the Canberra's crew of three are visible in the shapely "greenhouse," and there is a feeling that in R.A.F. service two men should suffice—as planned in America—to man the Canberra.

R.A.F. Appointments

UNTIL recently Senior Air Liaison Officer, United Kingdom Service Liaison Staff, South Africa, A. Cdre. P. D. Cracroft, A.F.C., is to become A.O.C. No. 66 (Scottish) Group, Home Command. He will take up his new post next month.

G/C. B. L. Blofeld, C.B.E., has been appointed Director of Personal Services (B) at the Air Ministry as from November. Since last June he has been at No. 90 Group headquarters as Senior Administration Officer.

New R.N.V.R. Air Squadrons

THE strength of the air branch of the Royal Naval Volunteer Reserve is to be further increased by the formation of four new squadrons, which in the first instance will be used to provide additional training facilities for existing units.

Two of these squadrons, Nos. 1832A and 1832B, will be established by the Southern Air Division, R.N.V.R., based at R.N. Air Station Culham (Berks); another, No. 1840A, is to be set up by the Channel Air Division, which has its headquarters at Ford (Sussex), and the fourth, No. 1830A, by the Scottish Air Division at Donibristle (Fife).

Commanding officers are to be appointed shortly to the new units, and List 1 pilots and observers—those flying personnel capable of fulfilling the maximum training requirements—are to be posted to them. Non-flying officers and ratings will be attached to the divisions for duty.

Royal Inspection

AT Biggin Hill on Saturday, November 1st, the Queen Mother and Mr. Winston Churchill are to make a joint inspection of the Royal Auxiliary Air Force Squadrons, of which they are the Honorary Air Commodores. The Queen Mother's squadron, No. 600 (City of London) is commanded by S/L. J. P. Meadows, D.F.C., and that of the Prime Minister, No. 615 (County of Surrey) by S/L. F. B. Sowrey.

Kenley Ceremony

THE old fighter station at Kenley was the scene last Sunday afternoon of a ceremonial parade during which No. 661 A.O.P. Squadron, R.Aux.A.F., received its official badge. The presentation was made by A.V-M. W. J. Seward, C.B., C.B.E., A.O.C. No. 61 (E) Group, to Major R. J. Hutt, R.A., who commands the unit.

Accompanying A.V-M. Seward on the dais were Miss E. M. Marshall, J.P., chairman of the Caterham and Warlingham U.D.C., and Ald. S. R. C. Sumpter, J.P., Mayor of Hendon. Both accepted replica plaques of the badge for hanging in their respective council chambers. Caterham and Warlingham have adopted the squadron and Hendon has adopted No. 1958 Flight. Altogether No. 661 Squadron has four flights—two at Kenley and one each at Hendon and Henlow. A fifth is expected to be formed shortly.

Four camouflaged Austers formed a backcloth to the parade which, by the intermixing of khaki and blue uniforms, emphasized the integration of the two services necessary to perform the duties of an air observation post unit.

Drill was extremely smart and the ceremonial aspect was helped not a little by the presence of the W.R.A.F. Central Band.

No. 661 A.O.P. Squadron was first formed at Old Sarum in August, 1943.

On June 21st, 1944, "C" Flight landed in Normandy and was joined by the remainder of the unit a month later. The squadron fought in a number of famous engagements, including Falaise Gap, Walcheren, Arnhem and the Rhine crossing. For a short while before being disbanded in October, 1945, the unit performed communication-flight duties. It was re-formed as an R.Aux.A.F. Squadron in May, 1949.

The badge, which is one of the earliest to bear the Queen's signature, depicts a grenade enfiled by a compass-ring—denoting fire-power and accurate flying. The motto is *Designo oculis ad caedem* ("With my eyes I designate the victim").

Reunions

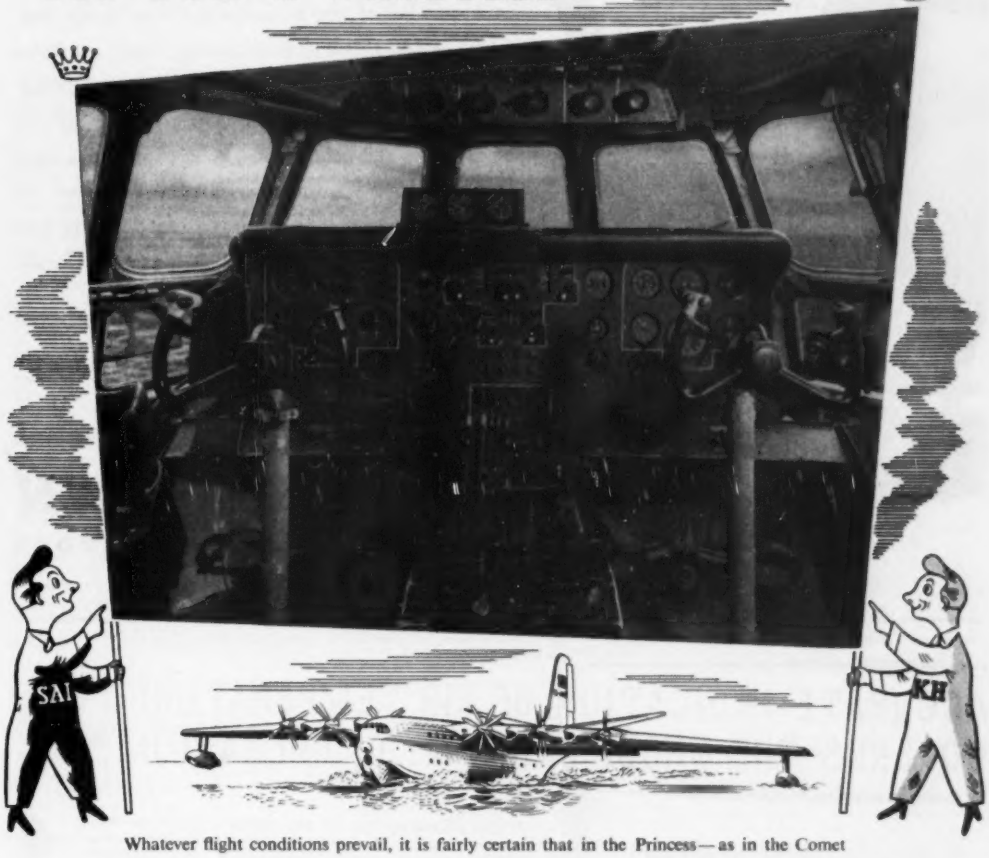
THE guest of honour at the University of London Air Squadron's dinner will be Marshal of the R.A.F. Sir John Slessor. The function will be held at the Park Lane Hotel on Wednesday, December 3rd. Past members are asked to obtain particulars from the secretary at U.L.A.S., 48 Princes Gardens, London, S.W.7.

Nos. 50 and 61 Squadrons R.A.F. are holding their joint reunion tomorrow, November 1st, at the New Inn, 254, Westminster Bridge Road, London, S.E.1. Mr. J. Lascelles, 15, Crantock Road, Catford, S.E.6, is the organizer.

FOR WARMER CLIMES: A.V-M. D. A. Boyle with Mrs. Boyle in front of his Canberra just before the departure of the R.A.F. South America Goodwill Mission (see page 552).

PRESENTATION: A.V-M. W. J. Seward hands No. 661 A.O.P. Squadron's new badge to Major R. J. Hutt, R.A., who commands the unit. Behind the Air Vice-marshal is the Mayor of Hendon. (See "Kenley Ceremony," above).

FIT FOR A PRINCESS



Whatever flight conditions prevail, it is fairly certain that in the Princess—as in the Comet —there will be a Smiths, Kelvin Hughes or Waymouth instrument to register them. This giant aircraft relies on numerous instruments supplied by the Smiths Group covering flight and engine performance, navigation, cabin pressure and fuel consumption.

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Listen to Group Captain Douglas Bader, D.S.O., D.F.C., appealing for the British Limbless Ex-Service Men's Association at 8.25 p.m. on the Home Service Programme on the 9th November.

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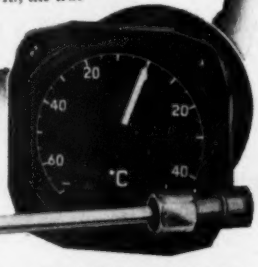
ACCURATE INDICATION OF AIR TEMPERATURE GOVERNS THE WHOLE ECONOMY OF OPERATION

Weston Thermometry has been chosen for several applications on the De Havilland 'Comet' including fuel temperature, cabin air temperature, wing and tail de-icing as well as outside air temperature.
Illustrated is the Model S.110G/9 Thermometer Bulb with its associated Indicator, the Model S.63 circular scale Ratiometer used for outside air temperatures.

Flight Planning The air temperature is one of the most important factors in the operation of a long-range jet aircraft as it influences the rate of climb, the heights at which the aircraft will cruise, and hence the true airspeed. The latter in turn determines the specific range (air miles per pound of fuel) since within limits, fuel consumption per hour at the normal cruising altitudes does not vary much. It can be seen therefore that air temperature controls the choice of flight path, largely determines the fuel load carried, and governs the whole economy of the operation. The effect of air temperature on Comet operations can be illustrated by the fact that a 10°C. rise in temperature reduces the cruising altitude by 2,000 ft., the true airspeed by 13 knots, and the cruising specific range by 2%.



From the article "Operating the Comet" by D. O. MacDougall in the May issue of Shell Aviation News.

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SERVICE AVIATION . . .

NAVAL AVIATION in KOREA

Official Account of Carrier Operations from November, 1951 to June, 1952

THIS narrative has been extracted from the Admiralty account of British Commonwealth Naval Operations in Korea. It is essentially factual, but many of the figures give a picture of the tremendous task performed by the carriers in Korean waters. The percentages of aircraft serviceability attained by the maintenance engineers, technical crews and deck handlers reflect great credit on their work—often carried out under very trying circumstances. The use of Sea Furies as dive bombers is interesting; their normal bomb load is 2 x 500 lb but 2 x 1,000 lb can be carried.

FOR some time the aircraft-carrier element in Western Korean waters has consisted of one Commonwealth carrier and one U.S. carrier. In November last the duties were being shared by H.M.A.S. *Sydney*, who had earlier relieved H.M.S. *Glory*, and the U.S.S. *Rendova*. The *Sydney* was mostly engaged on the west coast, but moved over to the east coast to take part in Operation Athenaeum—the co-ordinated air, gun and rocket strike against Hungnam on November 20th-21st.

During this period the *Sydney's* operations were hampered by extremely rough seas, high winds and snowstorms, but her Sea Fury and Firefly aircraft nevertheless flew 270 sorties. During the attack on Hungnam her aircraft carried out an extensive two-day strafing of military targets with bombs and rockets, and destroyed many important installations, started large fires in industrial areas, and severely damaged harbour installations and railway communications. Her aircraft also spotted for the guns of H.M.S. *Belfast*, H.M.A.S. *Tobruk*, and the Netherlands destroyer *Van Galen*.

On returning to the west coast the *Sydney* resumed attacks on enemy lines of supply and communication, and one mission of eight Fireflies destroyed four bridges with 16 bombs. Her aircraft also provided close air support for United Nations troops and spotted for H.M.S. *Ceylon* and H.M.S. *Mounts Bay*.

Towards the end of the year the *Sydney* returned to harbour after one patrol off the west coast, having flown 385 sorties against enemy targets, although weather was bad during the latter part of the patrol, high winds and heaving swell reducing her activity. Nevertheless, her average daily number of sorties was well over fifty. She had directed her attention mainly to the prevention of an enemy build-up during a lull in front-line fighting.

Dawn-to-dusk reconnaissance of the enemy-held coastal areas showed the presence of numerous junks and sampans, which were rocketed and strafed by the *Sydney's* Sea Furies, resulting in 16 junks and 21 sampans being destroyed and 51 junks and 37 sampans damaged. It was estimated that heavy casualties were inflicted during diving low-level strafing runs by both her Firefly and Sea Fury aircraft. Five gun positions were knocked out.

In a following patrol the *Sydney* experienced arctic weather conditions—snowstorms, high winds and temperatures far below freezing—but her squadrons nevertheless flew 362 sorties against a variety of enemy targets. During the patrol the 2,000th operational sortie was flown by a Firefly pilot, Sub-Lt. N. D. MacMillan, R.A.N. The Fireflies were engaged in interrupting enemy rail transport by attacking bridges and tunnels; ten railway bridges were destroyed and three damaged. Sea Fury aircraft carried out rocket attacks against enemy defences and gun positions and inflicted heavy casualties on enemy troops. Rear-Admiral A. K. Scott-Moncrieff witnessed some of the operations during a day spent on board.

On January 26th the *Sydney's* tour of duty ended and she was relieved by H.M.S. *Glory*. The *Glory*, escorted by H.M.A.S. *Warramunga*, returned to the war zone for a second tour of duty after a refit at Sydney.

The *Glory's* first period of operations was favoured by good flying weather, and she was able to show that she had lost none of her previous skill, although she had a considerable proportion of new pilots on board. In March there were some bad flying days, but the aircraft of the 14th Carrier Air Group, under the command of Lt. Cdr. F. A. Swanton, D.S.C., R.N., stepped up the number of sorties flown, and in one day she put up 105 sorties, each of normal duration. This was a record for a light fleet carrier and brought congratulatory signals from both American and British commanders. The Fifth Sea Lord, Vice-Admiral E. W. Anstice, C.B., signalled from the Admiralty "Congratulations upon your fine century on this day."

In dawn-to-dusk sorties the aircraft silenced enemy gun positions, strafed invasion boats and damaged a boat-yard. They dropped 70 bombs and fired over 400 rockets at targets which included an enemy troop headquarters and store houses.

Enemy troops working on a bridge diversion were killed or scattered. At one time every aircraft in the *Glory*, except one previously damaged, was airborne. All aircraft and all pilots flew three normal full-length sorties during the day, and some even completed four; a triumph of organisation in which the whole ship's company shared, particularly the deck handlers and technical crews.

About this time the *Glory's* two tours of duty in the war zone had brought her number of sorties flown to 4,000, and in 12 patrols she had steamed 77,000 miles.

In a subsequent patrol the *Glory's* Sea Furies, though not designed for such work, were armed with bombs instead of rockets. The results showed that the Sea Fury is a successful dive-bomber, and that the type of target available on the west coast can be hit harder by the bomb than by the rocket.

The *Glory's* second tour of duty was now drawing to a close, and during her last patrol Capt. T. A. K. Maunsell, R.N., flew to the ship in a U.S. Avenger aircraft to take over as commanding officer from Capt. K. S. Colquhoun, D.S.O., R.N. By early May the ship had completed her task and was relieved by H.M.S. *Ocean*. Since leaving the United Kingdom in January, 1951, she had then steamed some 85,000 miles, operated off four continents, made more than 6,400 aircraft launchings and had been screened by more than 60 destroyers of five different nations.

The 14th Carrier Air Group, commanded by Lt. Cdr. S. J. Hall, D.S.C., R.N., until December, 1951, and then by Lt. Cdr. F. A. Swanton, D.S.C., R.N., had set up a conspicuously high standard of operational flying, often against determined flak opposition, in providing support for ground and naval forces on the west coast, harassing the enemy's lines of communications.

No. 804 Sea Fury Squadron (Lt. Cdr. J. S. Bailey, O.B.E., R.N.) and No. 812 Firefly Squadron (Lt. Cdr. J. M. Culbertson, R.N.) flew some 4,835 operational sorties—a total of 11,860 flying hours. The cost of this extensive effort was 27 aircraft lost and more than 140 damaged, but the Air Group completed 4,838 deck landings with only 13 accidents; 16 pilots flew more than 130 sorties and Lt. K. Whitaker flew 149. A total of 24 aircrew were recovered from aircraft which crashed or were shot down, and the ship suffered the loss of nine aircrew killed and one wounded. The last 939 deck landings were completed, accident-free, on March 17th.

The *Glory's* aircraft hit the enemy with nearly a million rounds of 20 mm cannon shells, 14,000 rockets and well over 3,000 bombs, inflicting heavy and widespread damage on enemy road and rail communications, gun positions, barracks, bridges, store dumps, and other targets.

Contributing to the success of the Air Group's striking power was the efficiency of the hard-working maintenance engineers, under Lt. Cdr. (E) I. F. Pearson, R.N., who maintained almost 100 per cent. availability of aircraft throughout the two arduous tours of operations.

Lt. (E) Peter Barlow, R.N., one of H.M.S. *Glory's* air pilots, won an unusual trophy for hard-hitting attacks against the Communists in Korea. It was a "gun-busting" memento—a small brass model of a Russian type 76.2 mm gun made in the ship's air workshops—for successful attacks on enemy gun positions.

When the *Glory* left Korean waters the records of her pilots were confirmed by photographic evidence, and it was found that Lt. Barlow had obtained the most direct hits on enemy gun positions. The trophy, instigated by No. 804 Squadron (Sea Furies), was ceremoniously presented to him by the commanding officer.

Lt. Barlow wiped out three gun positions in four sorties, and in all his squadron accounted for 16 positions in 57 attacks. The destruction of such pin-point targets called for extremely accurate aiming.

When she relieved the *Glory*, H.M.S. *Ocean* flew a remarkably high sortie ratio and soon bettered the performances of all her predecessors. In one day the pilots of her two Squadrons, No. 802 (Sea Furies) commanded by Lt. Cdr. S. F. F. Shotton, D.S.C., R.N., and No. 825 Squadron (Fireflies), commanded by Cdr. C. K. Roberts, R.N., flew a total of 123 sorties against enemy-held positions, beating the *Glory's* record of 105 sorties in a day.

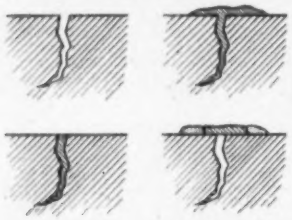
During this operational flying the carrier's pilots destroyed three railway bridges, an oil fuel dump, many coastal gun emplacements, 15 vehicles loaded with ammunition, and they attacked numerous troop encampments and store dumps. In all these attacks 72 bombs were dropped and 456 rockets fired. The *Ocean's* record was set up only four days after she returned to the operating area, and during this period her pilots dropped 279 bombs and fired 2,004 rockets.

THE INDUSTRY

The Thin Red Line

CRACK-DETECTION procedures have steadily developed for many years past and are used almost everywhere that metal is fabricated in any considerable quantity. An American process now available in this country is of the variety which operates on a non-electrical principle; known as "Met-L-Chek," it was developed by a former Northrop employee.

Met-L-Chek depends upon capilliary attraction for its effect. The suspected part is first cleaned—by vapour degreasing, if possible—and is then coated with a penetrant red dye. Small items can be dipped bodily in the dye, while possible crack areas on large units can be treated by brushing. Excess dye is removed by simple water-washing, and the area is then coated with a white "developer" fluid. This preparation contains tiny pores which act in a manner similar to blotting paper, the capillarity drawing the



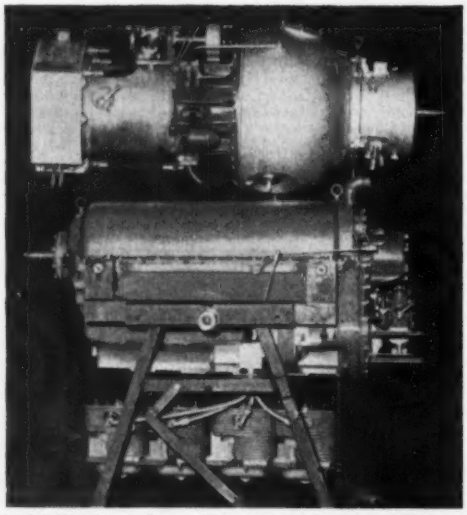
This series of sketches shows the manner in which the red dye penetrates to the bottom of a crack; is washed from the metal surface; and is finally drawn out by the developer fluid, shown dotted.

red dye out of the crack and spreading it along the crack surface, to become clearly visible to the naked eye.

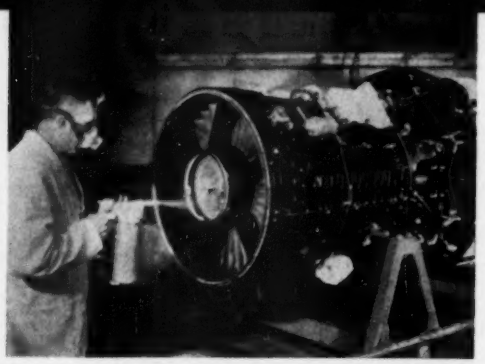
Solid red lines indicate cracks; groups of scattered dots show pitting or porosity; and a series of dots in line indicates a very tight crack or a cold shut. A wide, shallow crack should show up at once; but a deep and narrow defect may not assume its final form for several minutes.

An obvious shortcoming of the system is its inability to reveal the presence of flaws which may frequently be encountered just below the metal surface. But it is equally evident that the process has much to commend it; for example, an inspector should be capable of performing occasional tests with a small pocket outfit.

The fluids are being marketed in this country by C. J. Fox and Sons, Ltd., of 117, Victoria Street, London, S.W.1, who state that several tests of Met-L-Chek are now being carried out in the British aircraft industry with satisfactory results.



A NEW SHAPE in the factory of Blackburn and General Aircraft, Ltd., is this Turbaméca Palouste industrial gas turbine, seen in contrast with a Cirrus Major piston-engine. A note on this recent Blackburn development appeared last week.



PROTECTION AGAINST CORROSION: Powdered V.P.I. can, it is claimed, greatly lengthen the storage life of aero engines. It is easily sprayed on, as here shown; the engine is a Rolls-Royce Avon with starter removed. (See news item, "Preventing Rust Formation", below).

Preventing Rust-Formation

NO engineer needs reminding of the havoc which even slight rusting can cause on fine-tolerance machinery. Aero engines are especially vulnerable to such attack, partly because of their habit of "breathing" large volumes of air, and partly because of the necessity for preserving the utmost reliability and long life.

The well-established rust-preventing agents and inhibitors are all highly developed processes which have been operating with satisfaction for many years; they generally involve sealing the metal surface from the atmosphere and so preventing the corrosive reaction from being initiated.

The Shell Petroleum Company have developed a new anti-rust preparation which operates on a fundamentally different basis. Known as V.P.I. (vapour-phase inhibitor), it does not prevent the corrosive atmosphere from coming into contact with the part to be protected, nor does it react with, or remove, the water vapour or oxygen; instead, it operates in their presence to nullify any corrosive action. The active ingredient is a slightly volatile salt—di-cyclohexlammonium nitrite—which penetrates to every part of the machinery treated with V.P.I. and, it is claimed, affords complete immunity from rusting for several years.

When applied to gas turbines, or to spare parts, there is no lengthy de-preserving process. As proof of this, the Shell company cite the case of two engines from a Meteor which were exposed to the weather for two years and six weeks. One engine was V.P.I.-protected during this entire period, while the other was kept dry by a standard silica-gel dessicant for one year, V.P.I. then being applied for the remaining time. No trace of corrosion was found, and one engine was started up "on the spot," with hand priming only, to give full power on a normal run-up.

Various grades of V.P.I. are available and are already in use in a growing number of industries. Shell mention eight major airlines and several engine manufacturers who have tested the preparation and reported favourably. At present, V.P.I. is applied either in the form of a sprayed powder, or as a coating on paper. Five European countries are currently manufacturing V.P.I. paper under Shell licence.

New Post for Ex-Vickers Director

IT is announced that Mr. Bonner W. A. Dickson, who recently relinquished his seat on the Board of Vickers-Armstrongs, Ltd. has become a director of Oliver Pell Control, Ltd. (incorporating the Varley Magnet Company). This firm, whose offices are at Cambridge Row, London, S.E.18, is well known for the manufacture of solenoids for remote control; it also makes transformers, coils and other light electro-magnetic components.

Concurrently with his directorship, Mr. Dickson was general manager of the aircraft section of Vickers-Armstrongs, Ltd., and his 40 years' experience in that organization should be of particular value in his new appointment.

Scandinavian Tour

NOW on a six-week business trip in Northern Norway, beyond the Arctic Circle, is Mr. Paul Evans, Hoover, Ltd., assistant divisional export manager for Scandinavia. Mr. Evans was a Regular officer in the R.A.F. before the war, and rose to the rank of wing commander in Fighter Command, with which he served throughout World War II. He was awarded the D.F.C. and Queen Wilhelmina's personal award of Commander of the Order of Orange Nassau for his work with the Dutch Forces. He commanded the Malta Night Fighter Unit during the "blitz" on Malta and later was successively commander of No. 239 Mosquito Squadron and of R.A.F. Station, Croydon.

At the end of the war he joined B.E.A. and was their commercial manager in Scandinavia and later their manager in the South of France. After a year in the United States and the Caribbean he joined the export department of Hoover, Ltd., in 1949.

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In anticipation of their needs, for Radio Components and Accessories in particular, we feel we should AMPLIFY our recent message in this column, and give a VISUAL INDICATION of the further lists available in CONNECTION with Radio Equipment which we can so readily supply:

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10H	**Radio Connectors, Plugs, Sockets, etc.**
10HA / 10HZ	**Connectors.**
10J	**Controllers Electric, Aerial Switchgear, etc.**
10K / 10KB	**Power Units, Transformers, etc. (Radio and Radar).**
10L, 10LB	**Control Units and Assemblies.**
10PB	**Filter Units.**
10Q	**Visual Indicators.**
10U	**Amplifiers.**
10W, 10WZ	**Resistances.**
10X	**Crystals.**

Also CABLE of every type
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WING COMMANDER R. H. STOCKEN, F.R.Ae.S., Eagle House, 109, Jermyn St., London, S.W.1. Tel.: Whitehall 9363. [0419

CANADA-Gt. Britain Liaison service. Technical and Sales. Personal contact.—W. F. Dunpey, Consulting Air Engineer, Montreal Airport, Montreal, Canada. [0340A

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ALL types of aircraft insurance and personal accident cover.—Apply to J. W. T. Amery, Messrs. R. J. Moffat and Co., Percy House, 796, High Rd., Tottenham, N.17. Tel.: Tottenham 2002-4-5. [0804

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PUBLIC ANNOUNCEMENTS

AIR TRANSPORT ADVISORY COUNCIL.

THE Air Transport Advisory Council give notice that they have received the undermentioned applications to operate scheduled air services:

FROM Airwork, Ltd., of 11, Chesterfield Street, London, W.1:—

Application No. 85 for a Colonial Coach (Safari) service with Viking aircraft, for the carriage of passengers and supplementary freight between London (Blackbushe) and Nairobi with intermediate traffic stops at Malta, Wadi Halfa, Khartoum, Juba and Entebbe, at a frequency of from one to two services weekly during the period from January 1st, 1953, to December 31st, 1959.

Application No. 86 for a Colonial Coach service with York aircraft, for the carriage of passengers and supplementary freight between London (Blackbushe) and Salisbury (S. Rhodesia) at an initial frequency of from one to two services weekly, during the period from January 1st, 1953, to December 31st, 1959.

Application No. 87 for an all freight service with Bristol Freighter aircraft for the carriage of freight between London (Blackbushe) and Aden, with an intermediate traffic stop at Port Sudan, at an initial frequency of from one to seven services weekly, during the period from February 1st, 1953, to January 31st, 1960.

THESE applications will be considered by the Council under the terms of reference issued to them by the Minister of Civil Aviation on July 30, 1952. Any representations or objections with regard to these applications must be made in writing, stating the reasons, and must reach the Council within 14 days of the date of this advertisement, addressed to the Secretary, Air Transport Advisory Council, 9, Buckingham Gate, London, S.W.1, from whom further details of the applications may be obtained. When an objection is made to an application by another air transport company on the grounds that they are applying to operate the route or part of route in question, their applications, if not already submitted to the Council, must reach them within the period allowed for the making of representations or objections. [0843

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WOLVERHAMPTON AVIATION, LTD., offer for sale an Ekco Type CR.17/24, 26-volt, four-channel radio with crystals 116.1, 119.1, 119.7, 122.7.—Tel.: Fordhouses 2191. [0835

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The engagement of persons answering these advertisements must be made through the local office of the Ministry of Labour and National Service, etc., if the applicant is a man aged 18-64 or a woman aged 18-59 inclusive, unless he or she or the employer is excepted from the provisions of The Notification of Vacancies Order 1952.

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GREENGATE, MIDDLETON, MANCHESTER. [0813]

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(a) Servos systems
(b) Small electrical instruments
(c) Hydraulics or pneumatic systems
(d) Radar
(e) Electronics
Initial training will be considered in some cases. These are staff appointments with excellent prospects for those willing to expand their technical know-ledge and accept responsibility.—Applications, stating age, experience and qualifications, should be sent to Central Personnel Services, English Electric Co., Ltd., 336, Strand, W.C.2, quoting Reference 1025B. [0801]

NATIONAL RESEARCH COUNCIL OF CANADA
OTTAWA, ONTARIO, CANADA

THE Council requires staff as follows: for the development of new instruments for airborne and ground use UNIVERSITY graduate or post graduate in electrical or mechanical engineering, physics or mathematics, with at least three years' experience in the application and use of gyroscopes in navigational instruments and the development of low wander rate gyros. A knowledge of servo-mechanism theory and practice and associated equipment is desirable. Salary $3,700 to $5,200 depending on qualifications and experience.

TECHNICIAN having good technical training, both practical and theoretical, with not less than five years' experience in electronics, radio or gyro instrument work. Higher National Certificate qualification desirable. Salary $2,520 to $3,720 depending on qualifications and experience.

APPLICATION should be made on forms obtainable by writing and quoting reference number 2K8, to National Research Council of Canada, Africa House, Kingsway, London, W.C.2. [0797]

VICKERS-ARMSTRONGS, Ltd. (Aircraft Section), have vacancies at Hurn Depot for the following staff:—
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WEIGHTS ENGINEER
(for aircraft detail work in design office).

APPLY, in writing, to the Employment Manager, Vickers-Armstrongs, Ltd. (Aircraft Section), Weybridge, Surrey.

APPLICATIONS, with certain exceptions, are subject to the approval of the Ministry of Labour and National Service. [0819]

LICENSED radio engineer and radio mechanics at our base at Stansted Airport, Essex. Apply by letter or telephone to the Senior Radio Engineer, Aviation Traders, Ltd., Southend Airport, Essex. Tel.: Rochford 36491. [0850]

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require first class sound

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preferably with some experience of design, development and testing of jet engine accessories, particularly flow, acceleration and speed governing controls, burners and pumps. Exceptional prospects of advancement.

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required for development work on fuel systems. Experience on light hydraulic or pneumatic controls acceptable.

SENIOR DRAUGHTSMEN

for hydraulic and undercarriage department. Also required

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DRAUGHTSMEN
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Previous aircraft experience an advantage but not essential

Prospects are excellent for energetic and sound applicants

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SENIOR design and intermediate draughtsmen, preferably with aircraft experience for Cricklewood and Radlett offices. Considerations will be given to applicants with experience in light structural or mechanical engineering. Possession of O.N.C. or H.N.C. (Mech. or Elect.) an advantage.
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INDEX TO ADVERTISERS

	Page
Aerocontacts, Ltd.	30
Aircraft Materials, Ltd.	8
Alvis, Ltd.	17
Amal, Ltd.	28
Armstrong Siddeley Motors, Ltd.	13
Aviation Traders, Ltd.	27
B.B. Chemical Co., Ltd.	37
Birkett and Sons, Ltd., T. M.	4
Blackburn and General Aircraft, Ltd.	Cover i
Bristol Aeroplane Co., Ltd., The	Cover iv
British Legion, Haig's Fund	31
British Transfer Pty. Co., Ltd., The	31
Brown (Tractors), Ltd., David	26
Burnley Aircraft Products, Ltd.	8
Canadair, Ltd.	18
Cellon, Ltd.	24
Cross Manf. (1938), Ltd.	28
De Havilland Aircraft Co., Ltd., The	13, 16
Dowty Equipment, Ltd.	30
Electro-Hydraulics, Ltd.	5
E.M.I. Institutes	32
Fairey Aviation Co., Ltd., The	10
Feltham and Son, Ltd., Walter H.	31
Fox and Sons (Aviation), Ltd.	28
General Electric Co., Ltd., The	6
Gloster Aircraft Co., Ltd.	30
Godfrey and Partners, Ltd., Sir George	1
Greenwood (Willesden) Ltd., P. W.	4
Habershon and Sons Ltd., J. J.	2
Handley Page (Reading) Ltd.	31
High Duty Alloys, Ltd.	12
Hobson, Ltd., H. M.	Cover ii
Hymatic Engineering Co., Ltd., The	32
Lewis, Ltd., D.	28
Marconi's Wireless Telegraph Co., Ltd.	20
Oxygenaire (London), Ltd.	32
Plessey Co., Ltd., The	21
Ransome & Marles Bearing Co., Ltd.	23
Robinson and Co. (Gillingham), Ltd., L.	4
Roe and Co., Ltd., A. V.	31
Rotax, Ltd.	11
Sangamo Weston, Ltd.	26
Shell-Mex and B.P., Ltd.	19
Short Bros. and Harland, Ltd.	3
Simmonds Aerocessories, Ltd.	7
Staravia	28
Smiths Aircraft Instruments, Ltd.	25
Tecalemit, Ltd.	9
Teddington Controls, Ltd.	6
T.I. Aluminium, Ltd.	Cover iii
Uhlhorn Bros., Ltd.	32
Wakefield and Co., Ltd., C.C.	14
Western Manufacturing (Reading), Ltd.	2
Westland Aircraft, Ltd.	22
Wolverhampton Aviation, Ltd.	28

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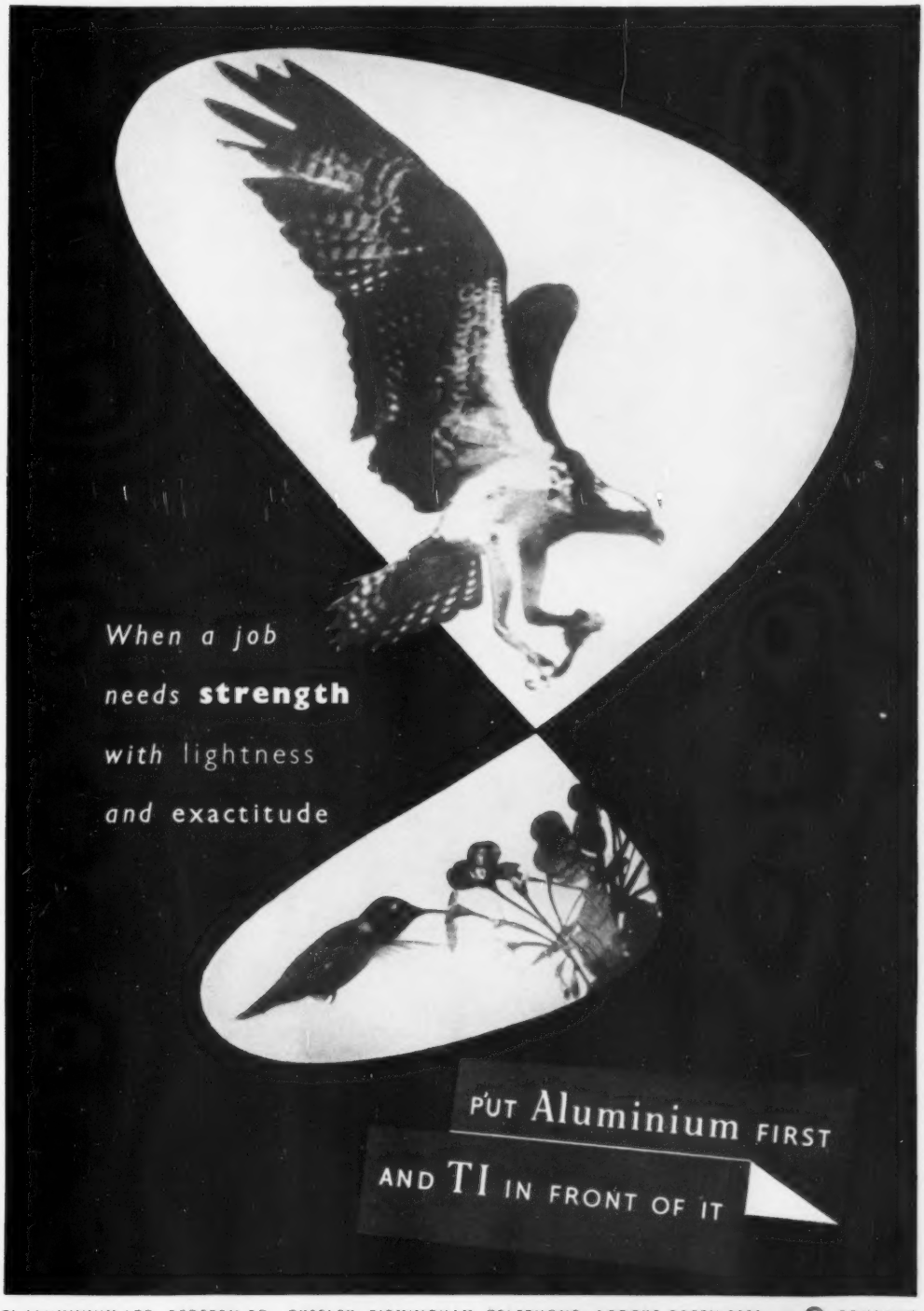

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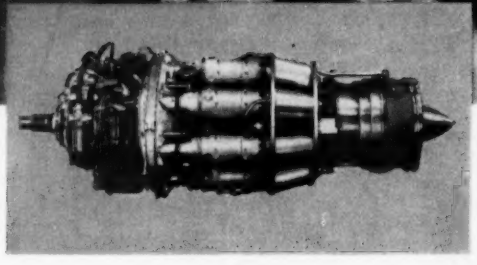

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